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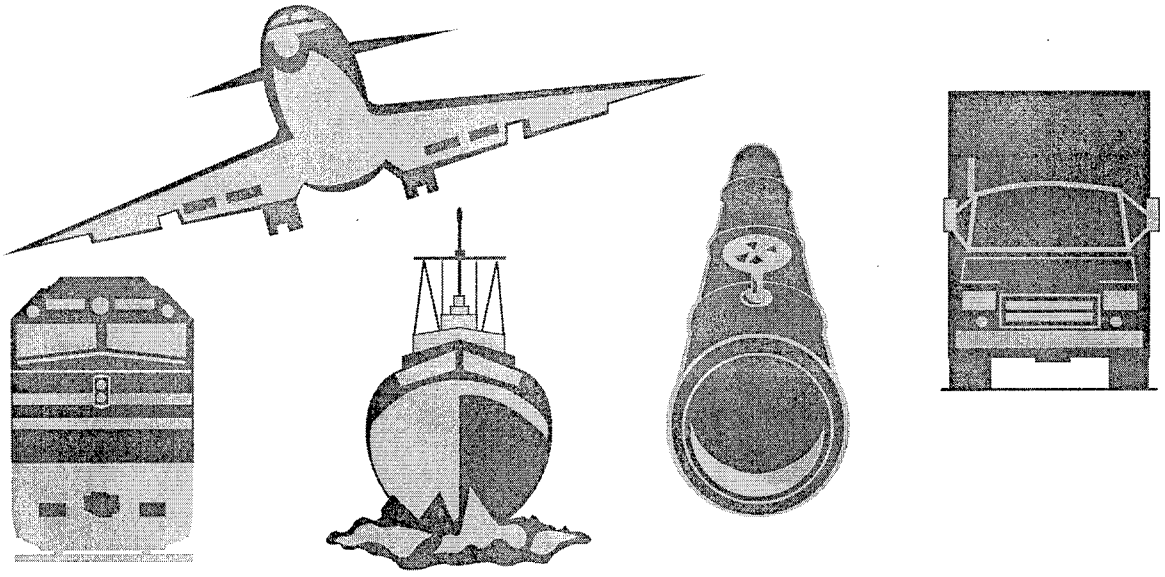
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SAFETY RECOMMENDATIONS

ADOPTED JULY 2002



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 3, 2002

In reply refer to: M-02-5 through -14

Admiral Thomas H. Collins
Commandant
U.S. Coast Guard
Washington, D.C. 20593-0001

On the evening of November 17, 2000, the U.S. small passenger vessel *Port Imperial Manhattan*, with three crewmembers and eight passengers on board, was en route to Weehawken, New Jersey, from the borough of Manhattan in New York City, New York, when a fire broke out in the engine room. Crewmembers attempted to extinguish the fire with portable extinguishers, with no success. The fire burned out of control, causing the vessel to lose power and forcing the crew and passengers to abandon the interior spaces. The crew and passengers were rescued by another NY Waterway passenger vessel, and the burning vessel was towed to Manhattan, where the New York City Fire Department extinguished the fire. One passenger was treated for smoke inhalation. No deaths resulted from this accident. The estimated cost to repair the vessel was $1.2 million.[1]

The National Transportation Safety Board determined that the probable cause of the fire on board the *Port Imperial Manhattan* was NY Waterway's inadequate inspection and maintenance of the vessel's electrical system. Contributing to the extent of the damage were the lack of a fixed fire detection and suppression system and the crewmembers' lack of knowledge of proper marine firefighting techniques. Based on its investigation, the Safety Board identified safety issues in the following areas: vessel maintenance; fire detection and suppression systems; crew response to the emergency; lifejacket stowage; safety information provided to passengers; and vessel communications.

From interviews with company officials and reviews of company documents, Safety Board investigators determined that NY Waterway did not have a preventive maintenance program for the hulls, the mechanical systems, and the electrical systems of the vessels in its fleet. Documentation provided by the company indicated that engineroom inspections had been made but lacked details indicating the scope of the maintenance performed and the intervals between the maintenance. Company officials

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[1] For further information, read: National Transportation Safety Board, *Fire on board the Small Passenger Vessel* Port Imperial Manhattan, *Hudson River, New York City, New York, November 17, 2000*, Marine Accident Report NTSB/MAR-02/02 (Washington, DC: NTSB, 2002).

stated that a circuit check had been conducted on the electrical system but could not say when the check had been done. Preventive maintenance of the electrical system would have included testing the circuits, checking the junction box, and tightening the electrical wires' connecting bolts, which, in this case, loosened over time and caused the fire.

While this accident resulted from inadequate maintenance of the electrical system, passenger safety cannot be ensured by maintenance of electrical systems alone. Shipboard mechanical systems consist of numerous moving parts that require planned inspections and maintenance to avoid unexpected breakdowns and unsafe conditions for passengers and crew. The preventive maintenance program developed by a company needs to address all systems affecting the safety of passenger vessels.

After the fire, NY Waterway introduced additional checksheets to improve the monthly maintenance of its vessels. However, the use of checksheets is not equivalent to the implementation of a comprehensive preventive maintenance program, which is much broader in scope. A preventive maintenance program for a fleet of vessels should include, as a minimum, established procedures for reporting maintenance and repair needs, for ensuring good interaction between vessel-operating personnel and shoreside maintenance staff, for conducting vessel inspections and repairs, for verifying and/or testing repairs, for retaining and reviewing maintenance and repair records, and for overseeing the maintenance and repair process.

The U.S. Coast Guard (Coast Guard) does not have specific regulations requiring a preventive maintenance program for small passenger vessels. The Federal regulators of other modes of transportation recognize the importance of preventive maintenance to the safety of operations and require that operators have a systematic program for performing inspections and maintenance. The Federal Aviation Administration has promulgated comprehensive maintenance requirements applicable to all airplane operators, which include provisions for inspections, repairs, and preventive maintenance.[2] The Federal Motor Carrier Safety Administration requires that every motor carrier systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles subject to its control,[3] In addition, the Federal Railroad Administration has extensive inspection and maintenance requirements for locomotives, train cars, crossing signals, and tracks.[4]

Because no authority other than the Coast Guard exercises oversight over domestic small passenger vessels, the Safety Board believes that the Coast Guard should require that companies operating domestic passenger vessels develop and implement a preventive maintenance program for all systems affecting the safe operation of their vessels, including the hull and the mechanical and electrical systems.

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[2] The requirements are specified at 14 CFR parts 43 and 91.

[3] Maintenance requirements are specified at 49 CFR 393.3.

[4] Inspection and maintenance requirements are specified at 49 CFR parts 213, 215, 229, and 231.

In this accident, the fire on the *Port Imperial Manhattan* probably was in the incipient phase for some time before entering the free-burning phase. Unfortunately, the crewmembers were unaware of the fire until it fully involved the engineroom. A fire detection system in the engineroom would have probably detected the fire during its incipient stage and alerted the crewmembers to the presence of a fire while it was still small enough for them to be able to extinguish it. However, the *Port Imperial Manhattan* did not have a fire detection system for its engineroom. Once the fire reached the free-burning stage, the crewmembers were faced with a much more serious and life-threatening fire.

According to Federal regulations, a vessel constructed, converted, or issued an initial Certificate of Inspection (COI) on or before March 10, 1996, is exempt from the requirement for fire detection systems unless the vessel's hull or machinery space boundary bulkhead or deck is composed of wood or fiber-reinforced plastic or its interior is sheathed with fiber-reinforced plastic. Because the *Port Imperial Manhattan* was built of aluminum in 1987, the vessel was not required to have a fire detection system.

The Safety Board does not consider the date of build, conversion, or certification to be an appropriate factor for determining whether a vessel should or should not be required to have an installed fire detection system. The sole reason for requiring the installation of such a system should be the risk factors involved. As with most small passenger vessels, the engineroom on the *Port Imperial Manhattan* was unmanned; no one was in the space to continuously monitor the fire-safe condition. Because the engineroom is the location of most ignition sources for fires, including hot surfaces, fuel and lubricating oils, and electrical equipment, this space is where the greatest fire risk exists on a vessel. Moreover, as the service life of a vessel increases, the potential for failure or breakdown in system components increases. As they age, engine hoses deteriorate, electrical parts fail, and the overall condition of an engineroom declines.

Because new small passenger vessels are required to have fire detection systems to protect their enginerooms and older existing vessels in the same service are not, two standards of safety exist. More importantly, the vessels with the higher risk are permitted to adhere to the lower standard. The Safety Board, therefore, believes that the Coast Guard should require that all small passenger vessels in commuter and ferry service, regardless of their date of build, be fitted with a fire detection system in the engineroom.

From the time that crewmembers discovered the *Port Imperial Manhattan*'s fire, it was beyond their capability to extinguish it with portable fire extinguishers. The vessel's fire main system was charged by a primary fire pump, which, in turn, was driven by the main diesel engine. The deckhands would have had to enter the engineroom in order to start the pump; however, they could not do so because the engineroom was on fire. The auxiliary fire pump served as a bilge pump during normal operations. However, to align the valves and activate the pump so that it would provide water to the fire main, the deckhands would have had to enter the engineroom, which was not possible.

Federal regulations require that "new" small passenger vessels, that is, those built, converted, or issued an initial COI on or after March 11, 1996, have a fire pump that is

capable of both remote operation from the operating station and local operation at the pump. Because the *Port Imperial Manhattan* was built before this cut-off date, it was not required to have remotely operated fire pumps. Had the fire pumps on the *Port Imperial Manhattan* been capable of remote operation, the deckhands might have been able to charge a fire hose and knock down the fire or limit its spread. Based on its findings in this accident, the Safety Board concluded that the lack of remotely operated fire pumps on the *Port Imperial Manhattan* compromised the ability of the crew to control the fire and that the lack of a remotely operated fire pumps on other small passenger vessels in commuter and ferry service built before March 11, 1996, similarly impairs the ability of their crews to control engineroom fires. The Safety Board therefore, believes that the Coast Guard should require that all small passenger vessels in commuter and ferry service, regardless of their date of build, be fitted with remotely operated fire pumps.

In the Safety Board's opinion, the most effective method that the crewmembers could have used to extinguish this fire would have been to seal the engineroom by closing all vent openings and doors and then activate a fixed fire suppression system. Unfortunately, the *Port Imperial Manhattan* was not equipped and was not required to be equipped with a fixed fire suppression system to protect its engineroom. If the *Port Imperial Manhattan* had been equipped with a fixed fire suppression system, it could have extinguished the fire before it spread to other parts of the vessel, thus limiting the damage to the vessel and the threat to the people on board. Further, it would have freed the deckhands of active firefighting duties and allowed them to concentrate their efforts on taking care of the passengers during the fire emergency.

At the time of the fire, the *Port Imperial Manhattan* was the only vessel in NY Waterway's fleet that did not have a fire detection and suppression system protecting its engineroom. As a result of this fire, NY Waterway plans to rebuild the *Port Imperial Manhattan* with a detection and suppression system for its engineroom.

The small passenger vessel industry continues to grow, and other owners and operators presently have many older vessels in service. While the Safety Board could not determine how many vessels certificated under Subchapter T were operating in commuter service, Coast Guard records indicate that of 4,835 small passenger vessels built before March 11, 1996, 951 were permitted to carry in excess of 100 passengers. Further, records of the Passenger Vessel Assocation indicate that its member companies, which have about 65 percent of the small passenger vessels in service nationwide, carry up to 200 million passengers annually. Because older vessels are not required to have fire suppression systems in their engineroom, the passengers on board these vessels are at increased risk. The Safety Board, therefore, believes that the Coast Guard should require that all small passenger vessels in commuter and ferry service, regardless of their date of build, be fitted with a fixed fire suppression system in their enginerooms.

In response to the fire on board the *Port Imperial Manhattan,* the crewmembers' first actions were directed at locating and fighting the fire and then at securing the safety of the passengers. Upon arriving at the access door to the engineroom, the deckhands did not follow accepted firefighting procedures for opening a door into a space suspected of being on fire. They simply opened the engine room door, which not only allowed

additional oxygen to enter the area and feed the fire but also put them at risk of injury. Once they identified that a fire was in the engineroom, the crewmembers did not immediately notify the master. Rather, they both stood at the doorway to the engineroom and tried to extinguish the fire using portable CO_2 extinguishers, which had no effect on the fire. Their actions demonstrated that they were not properly trained in the use and limitations of the various types of fire extinguishers. If they had been properly trained, they would have known that they could not control or extinguish the fire from a distance using portable devices.

Other actions of the deckhands exacerbated the fire and smoke conditions, which again demonstrates that they did not know how to properly respond to the fire. Before evacuating the main cabin, one deckhand opened the exterior door to the stern to allow smoke to dissipate from the main cabin. After evacuating the main cabin, crewmembers did not close the exterior stern door or the engineroom door. By leaving the doors to the engineroom and to the exterior stern open, the crew provided a source of fresh air to the fire and a pathway for the fire and smoke to spread beyond the engineroom into the main passenger cabin, eventually filling the main cabin with thick black smoke.

Federal regulations do not require that the masters and deckhands on small passenger vessels receive formal firefighting training. Rather, the requirements at 46 CFR 185.420 and 185.520 stipulate, in part, that the owner, charterer, master, or managing operator provide "instruction" to newly hired deckhands as to "the duties that the crewmember is expected to perform in an emergency," and that the master conduct "sufficient fire drills to make sure that each crew member is familiar with his or her duties during emergencies." The format and depth of the required instruction for new deckhands is not specified in the regulations but is left to the discretion of the individual company. Likewise, the requirement for masters to hold "sufficient fire drills to make sure that each crewmember is familiar with his or her duties" is subject to discretionary compliance in so far as the depth of "familiarity" with duties is concerned. However, because masters are not required to complete fire training, they are ill prepared to train others or to evaluate the effectiveness of drills.

The required instruction and drills aim at familiarizing crewmembers with duties to be performed during an emergency; they do not require that crewmembers receive in-depth training about how to perform those duties. Before the fire, NY Waterway, in accordance with Federal regulations, had provided basic familiarization instruction to its new employees and had required that regular fire drills be held under the direction of the vessel master. The instruction and drills, however, were not adequate to enable the crew to properly respond to the fire on the *Port Imperial Manhattan.*

The Safety Board has investigated past accidents on small passenger vessels where crew training in emergency procedures was a concern. On December 3, 1994, the small passenger vessel *Argo Commodore*, with 4 crewmembers and 41 passengers on board, was about 1 hour into a dinner cruise of San Francisco Bay, California, when crewmembers discovered a fire in the engineroom. In analyzing the crew's handling of the emergency, the Safety Board found their response effort was inadequate, in part, because they had not participated in firefighting or evacuation drills and had been given

ineffective on-the-job training.[5] As a result of its findings in the *Argo Commodore* accident investigation, the Safety Board issued the following safety recommendation to the Coast Guard:

> M-95-42
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> Verify crew competence and company preplanning for emergencies either by routinely witnessing emergency drills at every annual inspection or by some other means of regulatory oversight.

On January 10, 1996, the Coast Guard subsequently revised 46 CFR 185.524 requiring that Coast Guard marine inspectors conduct emergency drills during their annual inspections of vessels and log when such drills were conducted. Because the regulatory revision satisfied the intent of the recommended action, the Safety Board classified Safety Recommendation M-95-42 "Closed–Acceptable Alternate Action."

As a result of the same investigation, the Safety Board issued the following safety recommendation to the Coast Guard:

> M-95-40
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> Establish mandatory standards for qualifications and training of crewmembers aboard small passenger vessels.

In its response letter to the Safety Board, the Coast Guard stated that the CFR changes requiring the on-board training and drills in emergency procedures and equipment satisfied the recommendation. The Safety Board disagreed and, on March 12, 1997, classified Safety Recommendation M-95-40 "Closed–Unacceptable Action."

Effective marine firefighting requires responders to identify the phase and class of the fire and to determine the most efficient way to extinguish it. Firefighters have to understand basic fire chemistry, be aware of the causes of fire phenomena, such as flashover and backdraft, and know the procedures for properly executing both direct and indirect attacks on a fire. Firefighters must also know the proper use and limitations of extinguishing agents and firefighting equipment and the personal safety procedures to follow in conducting firefighting operations. From their actions, it was clear that, despite participating in regular drills, the *Port Imperial Manhattan*'s crewmembers lacked the basic knowledge of proper firefighting procedures and that their lack of knowledge rendered their efforts ineffective.

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[5] For more information, see National Transportation Safety Board, *Fire Aboard U.S. Small Passenger Vessel* Argo Commodore *in San Francisco Bay, California, December 3, 1994*, Marine Accident Report NTSB/MAR-95-03 (Washington, DC: NTSB, 1995).

There is a distinct difference between on-board drilling and formal training. Specifically, drilling reinforces training by applying the techniques learned to specific vessels and crews. As shown in the *Argo Commodore* and the *Port Imperial Manhattan* fires, such instruction and drills did not provide adequate training for the crews to respond correctly to the emergency. To its credit, NY Waterway has voluntarily instituted a new training program for all of its crewmembers, including captains and deckhands, which includes at least 1 day of training in marine firefighting. Such training probably should make the company's crews more knowledgeable of proper fire response measures.

The Safety Board considers it equally important for other small passenger vessel operators in the commuter trade to provide fire safety training to its deckhands. If a fire breaks out on board a commuter vessel, the deckhands will have to fight or control it until outside assistance can arrive. For their safety and for the safety of the passengers on board, these deckhands should be trained in proper procedures to follow and actions to take for all foreseeable fire scenarios. The Safety Board, therefore, believes that the Coast Guard should establish firefighting training requirements for crewmembers on board small passenger vessels in commuter and ferry service.

The Safety Board recognizes that the regulatory process takes a long time to complete and is convinced that some interim measure to provide improved training for these deckhands is needed to improve fire safety on small passenger vessels. Currently, Navigation and Vessel Inspection Circular (NVIC) No. 1-91, "Recommended Qualifications for Small Passenger Vessel Deckhands" provides the Coast Guard's guidance to the small passenger vessel industry on fire training and qualifications of deckhands. This document, however, contains merely a general outline of subject areas that deckhands should "be familiar with" rather than detailed guidance. Small passenger vessels in commuter and ferry service carry millions of passengers each year and these vessels continue to be vulnerable to fire. In light of the time needed to promulgate new regulations, and of the high number of passengers at risk, the Safety Board believes that, as an interim measure, the Coast Guard should revise NVIC No. 1-91 so that it provides more in-depth guidance in training and drills for firefighting on board small passenger vessels.

When the fire was discovered on the vessel, several passengers were in the main cabin and the others were on the upper deck. After one of the deckhands expended a portable fire extinguisher into the engineroom, he instructed the passengers in the main cabin to go to the foredeck. However, he did not inform them of the seriousness of the situation or provide them with lifejackets before they left the passenger cabin. When the passengers arrived at the foredeck, no crewmember was there to instruct them in emergency procedures or to manage their safety. The passengers milled about on the foredeck and began to discuss among themselves what they should do to protect themselves from the fire.

Neither the master nor the deckhands could attend to the passengers during the early stages of the emergency because they were trying to extinguish the fire or alert others to their situation. The inability of the crew to manage the passengers caused some passengers to panic and take actions that potentially placed them in jeopardy. One

passenger reentered the smoke-filled passenger cabin to retrieve lifejackets for him and the other passengers. This action placed him in a life-threatening situation in which he could have been overcome by the smoke before he could make it safely back to the foredeck. Another passenger, after hearing an explosion on board the vessel, had to be restrained from jumping into the river. Given the low visibility at night, the swiftness of the current, and the coldness of the water, a passenger jumping over the side without a lifejacket probably would have drowned before being located and rescued by responders.

During a shipboard emergency, crewmembers need to be able to take appropriate action to deal with the emergency and to protect their own safety as well as the safety of passengers. However, in order for crewmembers to maintain control of the passengers during an emergency, they must be properly trained. Crowd management courses should include, at a minimum, training in the following areas to enable crewmembers to assist passengers during emergencies:

- Awareness of emergency plans and instructions and the knowledge of emergency exits and evacuation restrictions;

- Ability to assist passengers en route to muster and embarkation stations, including how to give clear reassuring orders, how to control passenger movement, how to keep escape routes clear of obstructions, how to evacuate disabled people and those needing special assistance, and how to search accommodation spaces; and

- Knowledge of effective mustering procedures, including the ability to use effective procedures for keeping order and for reducing and avoiding panic and the ability to ensure that the passengers have donned their lifejackets correctly.

The instruction and drills provided to the crew of the *Port Imperial Manhattan* did not prepare them for providing the necessary control of the passengers during the fire emergency. Fortunately, only eight passengers were on board at the time of the fire. However, the vessel was certificated to carry as many as 350 passengers at one time and if more passengers had been on board and if they had panicked or taken actions that placed them in jeopardy, the consequences could have been significantly more serious.

Based on its findings in this accident, the Safety Board concluded that, without proper training, the masters and deckhands on small passenger vessels in commuter and ferry service are ill-prepared to control large numbers of passengers during fires or other shipboard emergencies. The Safety Board, therefore, believes that the Coast Guard should require that owners and operators of small passengers vessels in commuter and ferry service provide crowd control training to their vessel operating crews. The Safety Board furthermore believes that, in the interim, before regulatory requirements become effective, the Coast Guard should revise NVIC No. 1-91 to provide detailed guidance for the small passenger vessel industry concerning proper crowd control management procedures for masters and deckhands to follow during a shipboard fire or other emergency.

On the *Port Imperial Manhattan*, all of the passenger lifejackets were stowed in lockers at the aft end of the main cabin, next to the engineroom door, rather than distributed throughout the vessel. A passenger, and later the master, entered the smoke-filled cabin, risking serious injury, to retrieve lifejackets for the passengers. Adult and child-size lifejackets were not segregated in the lockers. Therefore, when the lifejackets were distributed, an adult passenger mistakenly received a child-size one.

Lifejackets are essential safety appliances that should be donned by the passengers in the earliest moments of a fire. Passengers may have to retrieve and don lifejackets without assistance because the crewmembers may be devoting their attention to the fire. Stowing lifejackets in one area on a vessel makes them vulnerable to becoming inaccessible during an emergency. For example, if the fire occurred between the crew and passengers and the stowage area, retrieving the lifejackets might be impossible. Using a single stowage area can also cause serious problems even when the area is not physically cut off. If a vessel were carrying a large number of passengers and they had to retrieve lifejackets from a central location, the crush of people all heading to the same location could incite panic and cause injury. In addition, stowing child-size lifejackets with adult-size lifejackets increases the chances that passengers will receive the wrong size jacket during an emergency.

The Safety Board is concerned that other operators of small passenger vessels have vessels on which the stowage of lifejackets is not properly distributed and/or the lifejackets are not segregated by size. Federal regulations stipulate that that lifejackets on small passenger vessels shall be stowed so that adult and child-size jackets are segregated from each other and that they are "in convenient places distributed throughout accommodation spaces." Coast Guard inspectors must check the lifejackets and stowage areas during their periodic examinations. However, as a practice, the vessel operators generally remove the jackets from their stowage locations to facilitate an inspector's review. As a result, inspectors can overlook problems related to the stowage of the lifejackets. The Safety Board, therefore, believes that the Coast Guard should issue a directive to small passenger vessel operators to review the distribution of lifejackets on board their vessels and to ensure that the lifejackets are accessible and segregated.

In this accident, the passengers on the *Port Imperial Manhattan* did not receive a verbal safety briefing before the onset of the voyage. Several passengers indicated that they didn't realize the potential seriousness of the situation when they were asked to move to the outer deck. Once on the foredeck, they discussed whether they needed lifejackets and what actions they might have to take.

The Safety Board has long been a proponent of safety briefings on small passenger vessels, encouraging owners and/or operators to incorporate prevoyage verbal safety briefings to passengers into their operating procedures and asking the Coast Guard to make safety briefings mandatory. A verbal safety briefing serves multiple purposes. It informs the passengers about emergency procedures and refreshes the crewmembers' understanding of those procedures. A safety briefing also gives passengers the opportunity to ask questions if they do not understand the procedures.

In its investigation of the 1994 *Argo Commodore* accident, the Safety Board found that the safety placard on the small passenger vessel did not fulfill its intended purpose. At that time, Federal regulations gave the owner the option of using either a safety placard or a safety briefing. Based on its findings in the *Argo Commodore* fire, the Safety Board issued the following safety recommendation to the Coast Guard:

> M-95-41
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> Require that the operators of small passenger vessels conduct a passenger safety briefing prior to departure to include: the location of lifesaving equipment; the use of such equipment; and proper procedures to follow during the course of an emergency evacuation or other on-board emergency.

As a result of this recommendation, the Coast Guard revised CFR 185.506 to require that the masters of small passenger vessels ensure that suitable public announcements are made informing all passengers of, among other safety information, the location of lifejackets, emergency exits, survival craft embarkation areas, and instructional placards for lifejackets and other lifesaving devices. The regulations also require that the crewmembers advise all passengers that they may be required to don lifejackets when hazardous conditions exist and that the passengers receive a demonstration either collectively or individually on how to don a lifejacket. The regulations, however, allow an exception to the requirement for a verbal safety brief. The regulation states, in part, "Ferries operating on short runs of less than 15 minutes may substitute bulkhead placards or signs for the announcement if the OCMI determines that the announcements are not practical due to the vessel's unique operation."

The Coast Guard had granted NY Waterway an exception from the verbal safety briefing to passengers at the onset of voyages because the trips of the company's vessels lasted less than 15 minutes. The exception did not eliminate the requirement for safety placards, and the *Port Imperial Manhattan* did have placards posted in the main cabin.

The Safety Board maintains that basic safety information needs to be announced to passengers on any vessel before the onset of waterborne operations, regardless of the length and duration of a voyage. An emergency can arise at any moment while the vessel is underway and, given the limited number of crewmembers per passenger, people need to be able to take basic initial actions for their own safety. Essential actions that adult passengers should be able to take include obtaining and donning lifejackets for themselves and for their children and going to the proper assembly area.

Vessel operators should not rely on passive notification such as posted placards to provide essential safety information to passengers. Passengers may not read placards before an emergency. On the other hand, a short verbal safety announcement can focus the attention of passengers on basic safety information that they need to know in order to respond correctly in the event of an emergency. Given the ready availability of technology that allows for prerecorded safety briefings to be aired over intercom and loudspeaker systems, commuter vessels and ferries can readily provide verbal safety briefs without crewmembers having to take time away from other vessel operation

activities. The Safety Board, therefore, believes that the Coast Guard should eliminate the waiver for verbal safety briefings and require that such briefings be given to passengers on all small passenger vessels.

In summary, the National Transportation Safety Board makes the following safety recommendations to the U.S. Coast Guard:

Require that companies operating domestic passenger vessels develop and implement a preventive maintenance program for all systems affecting the safe operation of their vessels, including the hull and the mechanical and electrical systems. (M-02-5)

Require that all small passenger vessels in commuter and ferry service, regardless of their date of build, be fitted with a fire detection system in the engineroom. (M-02-6)

Require that all small passenger vessels in commuter and ferry service, regardless of their date of build, be fitted with remotely operated fire pumps. (M-02-7)

Require that all small passenger vessels in commuter and ferry service, regardless of their date of build, be fitted with a fixed fire suppression system in the engineroom. (M-02-8)

Establish firefighting training requirements for crewmembers on board small passenger vessels in commuter and ferry service. (M-02-9)

Revise Navigation and Vessel Inspection Circular No. 1-91 so that it provides more in-depth guidance in training and drills for firefighting on board small passenger vessels. (M-02-10)

Require that owners and operators of small passengers vessels in commuter and ferry service provide crowd control training to their vessel operating crews. (M-02-11)

Revise Navigation and Vessel Inspection Circular No. 1-91 to provide detailed guidance for the small passenger vessel industry concerning proper crowd control management procedures for masters and deckhands to follow during a shipboard fire or other emergency. (M-02-12)

Issue a directive to small passenger vessel operators to review the distribution of lifejackets on board their vessels and to ensure that the lifejackets are accessible and segregated. (M-02-13)

Eliminate the waiver for verbal safety briefings and require that such briefings be given to passengers on all small passenger vessels. (M-02-14)

As a result of this investigation, the Safety Board also issued safety recommendations to the Federal Communications Commission, NY Waterway, and the Passenger Vessel Association. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendations. In your response to the recommendations in this letter, please refer to M-02-5 through -14. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 3, 2002

In reply refer to: M-02-15

Mr. Arthur Imperatore, Jr.
President
NY Waterway
Foot of Pershing Road
Weehawken, New Jersey 07086

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

The recommendation addresses the adequacy of vessel maintenance. The recommendation is derived from the Safety Board's investigation of the fire on board the small passenger vessel *Port Imperial Manhattan* in the Hudson River, New York City, New York, on November 17, 2000, and is consistent with the evidence we found and the analysis we performed.[1] As a result of this investigation, the Safety Board has issued safety recommendations to the U.S. Coast Guard, the Federal Communications Commission, the Passenger Vessel Association, and NY Waterway. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendation.

Based on its investigation, the National Transportation Safety Board determined that the probable cause of the fire on board the *Port Imperial Manhattan* was NY Waterway's inadequate inspection and maintenance of the vessel's electrical system. Contributing to the extent of the damage were the lack of a fixed fire detection and suppression system and the crewmembers' lack of knowledge of proper marine firefighting techniques.

From interviews with company officials and reviews of company documents, Safety Board investigators determined that NY Waterway did not have a preventive

[1] For further information, read: National Transportation Safety Board, *Fire on board the Small Passenger Vessel* Port Imperial Manhattan, *Hudson River, New York City, New York, November 17, 2000*, Marine Accident Report NTSB/MAR-02/02 (Washington, DC: NTSB, 2002).

maintenance program for the hulls, the mechanical systems, and the electrical systems of the vessels in its fleet. Documentation provided by the company indicated that engineroom inspections had been made but lacked details indicating the scope of the maintenance performed and the intervals between the maintenance. Company officials stated that a circuit check had been conducted on the 12-volt electrical system but could not say when the check had been performed. Preventive maintenance of the electrical system would have included testing the circuits, checking the junction box, and tightening the wire connecting bolts, which loosened over time and caused the fire.

After the fire, NY Waterway introduced additional checksheets to improve the monthly maintenance of its vessels. However, the use of checksheets is not equivalent to the implementation of a comprehensive preventive maintenance program, which is much broader in scope. A preventive maintenance program for a fleet of vessels should include, as a minimum, established procedures for reporting maintenance and repair needs, for ensuring good interaction between vessel-operating personnel and shoreside maintenance staff, for conducting vessel inspections and repairs, for verifying and/or testing repairs, for retaining and reviewing maintenance and repair records, and for overseeing the maintenance and repair process. Shipboard mechanical systems consist of numerous moving parts that require planned inspections and maintenance to avoid unexpected breakdowns and unsafe conditions for passengers and crew. The preventive maintenance program developed by a company needs to address all systems affecting the safety of passenger vessels.

The National Transportation Safety Board, therefore, makes the following safety recommendation to NY Waterway:

> For the vessels in your fleet, develop and implement a preventive maintenance program for systems affecting safe operation, including the hull and the mechanical and electrical systems. (M-02-15)

In your response to the recommendation in this letter, please refer to M-02-15. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 3, 2002

In reply refer to: M-02-16

Mr. John Groundwater
Executive Director
Passenger Vessel Association
801 North Quincy Street, Suite 200
Arlington, Virginia 22203

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

The recommendation addresses the adequacy of vessel maintenance. The recommendation is derived from the Safety Board's investigation of the fire on board the small passenger vessel *Port Imperial Manhattan* in the Hudson River, New York City, New York, on November 17, 2000, and is consistent with the evidence we found and the analysis we performed.[1] As a result of this investigation, the Safety Board has issued the safety recommendations to the U.S. Coast Guard, the Federal Communications Commission, NY Waterway, and the Passenger Vessel Association. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendation.

Based on its investigation, the National Transportation Safety Board determined that the probable cause of the fire on board the *Port Imperial Manhattan* was NY Waterway's inadequate inspection and maintenance of the vessel's electrical system. Contributing to the extent of the damage were the lack of a fixed fire detection and suppression system and the crewmembers' lack of knowledge of proper marine firefighting techniques.

From interviews with company officials and reviews of company documents, Safety Board investigators determined that NY Waterway did not have a preventive maintenance program for the hulls, the mechanical systems, and the electrical systems of

[1] For further information, read: National Transportation Safety Board, *Fire on board the Small Passenger Vessel* Port Imperial Manhattan, *Hudson River, New York City, New York, November 17, 2000*, Marine Accident Report NTSB/MAR-02/02 (Washington, DC: NTSB, 2002).

the vessels in its fleet. Documentation provided by the company indicated that engineroom inspections had been made but lacked details indicating the scope of the maintenance performed and the intervals between the maintenance. Company officials stated that a circuit check had been conducted on the 12-volt electrical system but could not say when the check had been performed. Preventive maintenance of the electrical system would have included testing the circuits, checking the junction box, and tightening the wire connecting bolts, which loosened over time and caused the fire.

While this accident resulted from inadequate maintenance of the electrical system, passenger safety cannot be ensured by maintenance of electrical systems alone. Shipboard mechanical systems consist of numerous moving parts that require planned inspections and maintenance to avoid unexpected breakdowns and unsafe conditions for passengers and crew. The preventive maintenance program developed by a company needs to address all systems affecting the safety of passenger vessels.

After the fire, NY Waterway introduced additional checksheets to improve the monthly maintenance of its vessels. However, the use of checksheets is not equivalent to the implementation of a comprehensive preventive maintenance program, which is much broader in scope. A preventive maintenance program for a fleet of vessels should include, as a minimum, established procedures for reporting maintenance and repair needs, for interacting between vessel-operating personnel and shoreside maintenance staff, for conducting vessel inspections and repairs, for verifying and/or testing repairs, for retaining and reviewing maintenance and repair records, and for overseeing the maintenance and repair process.

The Coast Guard does not have specific regulations requiring a preventive maintenance program for small passenger vessels. The Federal regulators of other modes of transportation recognize the importance of preventive maintenance to the safety of operations and require that operators have a systematic program for performing inspections and maintenance. As a result of the *Port Imperial Manhattan* accident and other small vessel fires, the Safety Board is asking the Coast Guard to promulgate regulations for such programs. However, given that the rule-making effort is likely to be a time-consuming process, the Safety Board is convinced that interim measures addressing this safety issue are needed within the small passenger vessel industry.

More than 350 vessel owners and operators of small passenger vessels, or about 65 percent of the owner-operators nationwide, belong to the Passenger Vessel Association (PVA). The Safety Board is aware that an objective of the PVA is to assist its member companies improve the safety of their passenger vessel operations and that the association has published risk management and training manuals for that purpose. The risk management manual includes a safety audit guide containing checklists for inspecting vessels for hazardous conditions that could lead to slips, trips, falls, and injuries to passengers and crewmembers. The manual briefly mentions that engineroom, safety, and deck equipment inspection logs are useful for conducting proper maintenance. The training manual provides information for training deckhands in several areas, including safety precautions for engineroom operations. The manual also contains a primer on small passenger vessel machinery operations and systems.

While the PVA's voluntary guidelines cover several areas of passenger and vessel safety, the Safety Board found that the PVA does not provide adequate guidance to companies for establishing preventive maintenance programs for the hull and the machinery and electrical systems. In addition to operational checks, PVA guidelines should stress the importance of vessel maintenance and list machinery, electrical, and hull items that require periodic inspection and maintenance by a company's maintenance staff. The guidelines for preventive maintenance should describe, for example, procedures for reporting maintenance and repair needs, for ensuring good interaction between vessel-operating personnel and shoreside maintenance staff, for conducting vessel inspections and repairs, for verifying and testing repair work, for retaining and reviewing maintenance and repair records, and overseeing the maintenance and repair process for its fleet. Given the large number of passengers that are carried on small passenger vessels and ferries today and the commensurate safety risks, preventive maintenance should be performed on a regular basis.

Although the PVA does not include the entire domestic small passenger vessel fleet, its members represent a large enough portion of the industry to incrementally improve the level of small passenger vessel safety.

The National Transportation Safety Board, therefore, makes the following safety recommendation to the Passenger Vessel Association:

> Provide your members with guidelines for developing a preventive maintenance program for all systems affecting the safe operation of their vessels, including the hull and the mechanical and electrical systems. (M-02-16)

In your response to the recommendation in this letter, please refer to M-02-16. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 3, 2002

In reply refer to: M-02-17

Honorable Michael K. Powell
Chairman
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

The recommendation addresses the issue of vessel communications. The recommendation is derived from the Safety Board's investigation of the fire on board the small passenger vessel *Port Imperial Manhattan* in the Hudson River, New York City, New York, on November 17, 2000, and is consistent with the evidence we found and the analysis we performed.[1] As a result of this investigation, the Safety Board has issued the safety recommendations to the U.S. Coast Guard, the Federal Communications Commission, NY Waterway, and the Passenger Vessel Association. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendation.

To familiarize you with the events of the accident, the U.S. small passenger vessel *Port Imperial Manhattan* was carrying 11 people on an evening commuter run from Manhattan to Weehawken, New Jersey, when a fire broke out. The crew attempted to put out the fire with portable extinguishers, with no success. The fire burned out of control, causing the vessel to lose power and forcing the crew and passengers to abandon the interior spaces. They transferred to another NY Waterway vessel, and the burning vessel was towed to Manhattan, where the New York City Fire Department extinguished the fire. One passenger was treated for smoke inhalation. Estimated damage to the *Port Imperial Manhattan* was $1.2 million.

[1] For further information, read: National Transportation Safety Board, *Fire on board the Small Passenger Vessel* Port Imperial Manhattan, *Hudson River, New York City, New York, November 17, 2000*, Marine Accident Report NTSB/MAR-02/02 (Washington, DC: NTSB, 2002).

According to the master of the *Port Imperial Manhattan*, shortly after the vessel had departed the Manhattan pier, he saw smoke coming from the engine room vent. He made a VHF radiotelephone call requesting a nearby NY Waterway vessel to standby; however, moments later, the *Port Imperial Manhattan*'s radio became inoperative when the fire burned through the electrical cables to the pilothouse. The VHF radiotelephones on the *Port Imperial Manhattan* were not outfitted with an emergency source of power that enabled them to operate in the event of a power failure; no emergency backup was required for the small passenger vessel because it measured less than 100 gross tons. Federal Communications Commission (FCC) requirements at 47 CFR 80.917, "Compulsory Radiotelephone Installation for Small Passenger Boats," stipulate:

> (a) A vessel of more than 100 gross tons the keel of which was laid after March 1, 1957, must have a reserve power supply located on the same deck as the main wheel house or at least one deck above the vessel's main deck, unless the main power supply is so situated.

Based on its findings in this accident, the Safety Board concluded that the loss of VHF radiotelephone communication unnecessarily increased the risk to passengers and crewmembers. After losing power to the VHF radiotelephone, the *Port Imperial Manhattan* could not communicate with emergency response vessels and other river traffic. If a passenger had jumped or fallen overboard into the water, the *Port Imperial Manhattan* did not have the capability to inform other boats, including the rescue boat, which would have further endangered the person in the water. The *Port Imperial Manhattan* also would not have been able to inform the rescue boat about any injuries to its passengers or crewmembers in order to arrange for appropriate medical transport and service. Without a working radio, the *Port Imperial Manhattan* could not even confirm the number of people on board. In contrast, if the *Port Imperial Manhattan* had been equipped with radio backup, the vessel's crewmembers would have been able to inform the rescue boats of the seriousness of the situation and helped coordinate the rescue operation, perhaps hastening the process.

Although the *Port Imperial Manhattan* is less than 100 gross tons and, therefore, not currently required by regulation to have an emergency source of power for its VHF radiotelephone, after this accident, the operator of the vessel, NY Waterway, installed battery backups for the communications systems in the wheelhouses of all vessels in its fleet. The Safety Board is concerned, however, that other operators of commuter passenger vessels measuring less than 100 gross tons might not voluntarily make such an improvement. The Safety Board is convinced that without a backup source of power to the VHF radiotelephone, the crewmembers and passengers on small commuter vessels are at increased risk in the event of a loss of power.

The National Transportation Safety Board, therefore, makes the following safety recommendation to the Federal Communications Commission:

Require that small passenger vessels have VHF radiotelephone communications systems on board that can operate even when the vessel loses power. (M-02-17)

In your response to the recommendation in this letter, please refer to M-02-17. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 9, 2002

In reply refer to: A-02-13 and -14

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 29, 2000, the flight crew of a McDonnell Douglas[1] DC-9-32, N826AT, operating as AirTran Airways flight 956, executed an emergency landing at Hartsfield Atlanta International Airport (ATL), Atlanta, Georgia. Shortly after departing ATL, the flight crew observed numerous circuit breakers trip and several annunciator panel lights illuminate and declared an emergency. After the landing, one of the flight attendants reported to the flight crew that smoke could be seen emanating from the left sidewall in the forward cabin; air traffic control personnel also notified the flight crew that smoke was coming from the airplane. The flight crew then initiated an emergency evacuation on one of the taxiways. Airport rescue and firefighting personnel assisted in subduing the fire. No serious injuries were reported, and the airplane sustained substantial damage.

Examination of the airplane revealed fire damage to the left forward areas of the fuselage and cargo compartment from fuselage stations (FS) 237 to 313 and damage to the cabin floor. Fire damage was concentrated in an area just aft of the electrical disconnect panel located at FS 237, which is a junction panel for seven wire bundles. The fuselage exterior also exhibited heat discoloration in an area beneath the lavatory service panel located between FS 237 and 256 and a soot trail that extended aft from the radio rack vent, located just aft of the lavatory service panel. Soot was also present throughout the forward cargo compartment and on the cabin outflow valve near the rear of the airplane. Further examination of the interior area between the forward cargo compartment and the fuselage revealed bluish stains (similar in color to lavatory rinse fluid) on sidewall insulation blankets and components near FS 237. No drip shield was installed above the FS 237 disconnect panel at the time of the accident, although support brackets for the drip shield were in place.[2]

[1] McDonnell Douglas Corporation is now known as Boeing, Douglas Product Division.

[2] To protect the connectors at the FS 237 disconnect panel from overhead fluid leakage, a drip shield was incorporated on DC-9 airplanes above the FS 237 disconnect panel beginning with fuselage line number 271, which

Damaged wiring was removed from the area around FS 237 and sent to the National Transportation Safety Board's laboratory for detailed examination. Beading was observed on the ends of many individual wires, which is consistent with heat damage from arcing. Each of the seven electrical connectors from the wire bundles was opened to determine its internal condition. One connector (P1/R5-1061) exhibited more thermal damage than the other six and contained light-blue and turquoise-green crystalline deposits on the mating surfaces of its two sides, as well as around nearly all of its pins. This connector also exhibited evidence of pin-to-pin shorts. Laboratory tests of the grommet material from this connector revealed elevated levels of sulfate (a basic chemical constituent in lavatory rinse fluid) as compared to undamaged grommet material.

Safety Board investigators examined the area around the FS 237 disconnect panel on another AirTran DC-9 and on two DC-9s of another operator. Although a drip shield was installed above the FS 237 disconnect panel on the AirTran DC-9, protecting the components directly beneath it, bluish dried stains were observed on many surfaces near the FS 237 disconnect panel on the AirTran DC-9, including the bulkhead at FS 218 and on the ducts, wiring, insulation blankets, and sidewall. Neither of the DC-9s from the other operator contained a drip shield over the FS 237 disconnect panel. Although no blue stains were observed on or near the area of the disconnect panels in these airplanes, many components were covered with a white, mottled substance, which suggests that a fluid other than lavatory rinse fluid may have leaked from above.

The Safety Board is aware of two incidents involving the military equivalent of the DC-9 that involved circumstances similar to the accident involving N826AT. On September 21, 1999, the flight crew of a U.S. Air Force C-9A observed the illumination of several warning lights followed immediately by numerous circuit breakers popping in succession. Details provided by the Air Force indicated that lavatory fluid had leaked beneath the lavatory floor, leading to shorting, arcing, and fire damage to electrical components in the area of the forward cargo compartment (a drip shield was installed above the FS 237 disconnect panel). The other C-9A incident occurred on May 26, 2001. As with the earlier event, the incident flight crew noticed several warning lights illuminate and heard circuit breakers popping. Investigation revealed damage to electrical components in the forward cargo compartment area due to shorting and arcing from fluid saturation (a drip shield was installed above the FS 237 disconnect panel on this airplane, as well).

According to Boeing's DC-9 maintenance manual, servicing the DC-9 lavatory waste disposal system consists of draining, washing, and flushing the waste tank and then recharging it by adding new rinse fluid. Boeing's DC-9 maintenance manual recommends that a minimum of 3.5 gallons of new fluid be added to waste tanks[3] during lavatory servicing. AirTran's current servicing procedures, which were in place at the time of the accident, stipulate that at least 3.5 gallons but no more than 4.0 gallons of rinse fluid should be added when servicing the

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included N826AT. N826AT was delivered with the drip shield installed, but it was not determined why the shield was not in place at the time of the accident. Of the first 271 DC-9s manufactured, 80 included a forward lavatory.

[3] The forward waste tank, which is located above FS 237, has a capacity of 14 gallons. DC-9s also have an aft lavatory waste tank, which is not located above an electrical disconnect panel.

lavatory. However, at the time of the accident, neither Boeing's nor AirTran's procedures specified how to determine when the tank has been completely drained. Incompletely draining the tank can, over time, lead to an overflow of fluid onto the lavatory floor; the fluid can then migrate beneath the floor and onto components below, especially in areas where the floor panels are not properly sealed. Following the accident involving N826AT, AirTran revised its lavatory servicing procedures to emphasize the importance of completely draining the waste tank to avoid overflows.

As a result of the accident involving AirTran flight 956, Boeing issued Alert Service Bulletin (ASB) DC9-24A190 on July 31, 2001, to all operators of DC-9 airplanes. The ASB recommends that operators visually inspect the connectors at the FS 237 disconnect panel for evidence of lavatory rinse fluid contamination and that they install a drip shield over the disconnect panel. To prevent waste tank overflows, Boeing also issued Service Letter (SL) DC-9-SL-53-101 on March 22, 2002, to operators to stress the importance of properly sealing floor panels and adhering to lavatory servicing procedures specified in the DC-9 maintenance manual.

Findings in the Safety Board's investigation of the accident involving AirTran flight 956 highlight the hazards of lavatory fluid contamination of electrical components and the importance of shielding these components. Investigators' observations during their inspection of the area around the FS 237 disconnect panel on another AirTran DC-9 demonstrate that the connectors in this area would have been contaminated if not for the drip shield that was installed directly above them. Because all DC-9s are not equipped with a drip shield to protect the FS 237 disconnect panel from fluid contamination, the Safety Board believes that the Federal Aviation Administration (FAA) should require all DC-9 operators to visually inspect the electrical connectors at FS 237 for evidence of lavatory rinse fluid contamination and for the presence of a drip shield above the disconnect panel in accordance with Boeing ASB DC9-24A190. Connectors with internal contamination should be replaced.

In addition, to further address the hazards of fluid contamination due to improper lavatory servicing on DC-9 airplanes, the Safety Board believes that the FAA should issue a flight standards information bulletin to principal inspectors of DC-9 operators that discusses the circumstances of the accident involving AirTran flight 956 and stresses the importance of properly servicing and draining lavatory waste tanks and sealing floor panels in areas of probable fluid contamination, as indicated in Boeing SL DC-9-SL-53-101.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require all DC-9 operators to visually inspect the electrical connectors at fuselage station 237 for evidence of lavatory rinse fluid contamination and for the presence of a drip shield above the disconnect panel in accordance with Boeing Alert Service Bulletin DC9-24A190. Connectors with internal contamination should be replaced. (A-02-13)

Issue a flight standards information bulletin to principal inspectors of DC-9 operators that discusses the circumstances of the accident involving AirTran flight 956 and stresses the importance of properly servicing and draining lavatory waste tanks and sealing floor panels in areas of probable fluid contamination, as indicated in Boeing Service Letter DC-9-SL-53-101. (A-02-14)

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 16, 2002

In reply refer to: R-02-16

Honorable Allan Rutter
Administrator
Federal Railroad Administration
1120 Vermont Avenue, N.W.
Washington, D.C. 20590

About 3:45 a.m., eastern daylight time, on July 14, 2001, at the ATOFINA Chemicals, Inc., (ATOFINA) plant in Riverview, Michigan, a pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. About 4:09 a.m., shortly after the Riverview Fire Department chief arrived on scene, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball about 200 feet into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, a poisonous gas that is also an oxidizer. The fire was extinguished about 9:30 a.m. Three plant employees were killed in the accident. There were several other injuries; most of the injured were treated for respiratory symptoms and released. About 2,000 residents were evacuated from their homes for about 10 hours. Two tank cars, railroad track, and plant equipment (including hoses and fittings) were damaged in the fire.[1]

The Safety Board determined that the probable cause of the accident was a fractured cargo transfer pipe that resulted from (1) the failure of ATOFINA to adequately inspect and maintain its cargo transfer equipment, and (2) inadequate Federal oversight of unloading operations involving hazardous materials. Contributing to the accident was ATOFINA's reliance on a tank car excess flow valve to close in the event of a leak from cargo transfer equipment and the company's failure to require appropriate safety equipment for employees involved in tank car loading and unloading operations.

Both the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) required ATOFINA to develop and document safety plans for the Riverview facility that included safeguards intended to reduce the risk and consequences of catastrophic releases of hazardous materials. ATOFINA's risk management plan (mandated by the EPA) and process hazard analysis (mandated by OSHA) included an accident scenario that involved the failure of a flexible hose on the unloading apparatus for a methyl mercaptan tank car—a scenario similar to this accident. Under both plans, ATOFINA indicated that the release of methyl mercaptan would be stopped by the automatic closure of the tank car's excess flow valve. Further, ATOFINA's risk management plans explicitly noted that excess flow valves on the tank car would activate in the event of a pipeline or unloading hose rupture. However, when the transfer pipe failed on July 14, 2001, the excess flow valve on the tank car did not close and stop the release of the methyl mercaptan.

[1] For more information, see National Transportation Safety Board, *Hazardous Materials Release From Railroad Tank Car With Subsequent Fire at Riverside, Michigan, July 14, 2001.* Hazardous Materials Accident Report NTSB/HZM-02/01 (Washington, D.C.: NTSB, 2002).

Calculations made by Safety Board engineers and parties to the investigation indicated that the flow rate of methyl mercaptan through the broken transfer piping was insufficient to cause the excess flow valve to close. Excess flow valves are designed to close and stop the release of product from the tank car in the event a tank car valve or fitting is broken or sheared off during transit. Attaching cargo transfer apparatus to a tank car can change product release rates and flow rate characteristics and can prevent the excess flow valve from closing in the event of an emergency. As noted by the Chlorine Institute in its *Chlorine Manual* and by the Safety Board in its investigation of a July 30, 1983, accident at the Formosa Plastics plant in Baton Rouge, Louisiana,[2] tank car excess flow valves are not designed to act as an emergency shutoff device during cargo transfer.[3] Therefore, the Safety Board concluded that reliance on tank car excess flow valves to stop leaks during tank car cargo transfer operations is inappropriate.

To determine whether reliance upon tank car excess flow valves as safety mechanisms during transfer operations is restricted to ATOFINA or is a broader problem, Safety Board investigators interviewed a sampling of domestic chemical companies. Interviews with personnel responsible for company safety plans revealed that six of nine companies surveyed rely on tank car excess flow valves as a method of stopping or limiting a leak in the transfer equipment. Only one company reported having remotely operated shutoff valves on the unloading piping just outside the tank car dome. (The other two companies did not respond to the Safety Board's inquiry.) Although the Safety Board's sampling was limited, the results suggest that the inappropriate use of tank car excess flow valves may be a widespread practice in the chemical industry.

Therefore, the National Transportation Safety Board makes the following safety recommendation to the Federal Railroad Administration:

> Issue a hazardous materials bulletin to warn companies involved in tank car loading and unloading operations that tank car excess flow valves cannot be relied upon to stop leaks that occur during those operations. (R-02-16)

The Safety Board also issued safety recommendations to the U.S. Department of Transportation, the Environmental Protection Agency, and the Occupational Safety and Health Administration.

Please refer to Safety Recommendation R-02-16 in your reply. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

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[2] National Transportation Safety Board, *Vinyl Chloride Monomer Release From a Railroad Tank Car and Fire, Formosa Plastics Corporation Plant, Baton Rouge, Louisiana, July 30, 1983*, Hazardous Material Accident Report NTSB/HZM-85/08 (Washington, D.C.: NTSB, 1985).

[3] Although excess flow valves are routinely used as safety mechanisms in the piping systems of fixed facilities, those excess flow valves are designed and constructed for specific piping systems and the properties of the material flowing through the pipe.

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 16, 2002

In reply refer to: I-02-4 and R-02-17

Honorable Christine Whitman
Administrator
U.S. Environmental Protection Agency
Ariel Rios Building, Room 3000
1200 Pennsylvania Avenue
Washington DC 20460

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the adequacy of Federal regulations and oversight for cargo transfer operations involving bulk containers transporting hazardous materials. The recommendation is derived from the Safety Board's investigation of the July 14, 2001, hazardous materials accident at the ATOFINA Chemicals, Inc., (ATOFINA) plant in Riverview, Michigan, and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued six safety recommendations, two of which are addressed to the Environmental Protection Agency (EPA). Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

About 3:45 a.m., eastern daylight time, on July 14, 2001, at the ATOFINA plant in Riverview, Michigan, a pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. About 4:09 a.m., shortly after the Riverview Fire Department chief arrived on scene, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball about 200 feet into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, a poisonous gas that is also an oxidizer. The fire was extinguished about 9:30 a.m. Three plant employees were killed in the accident. There were several other injuries; most of the injured were treated for respiratory symptoms and released. About 2,000 residents were evacuated from their homes for about 10 hours. Two tank cars, railroad track, and plant equipment (including hoses and fittings) were damaged in the fire.[1]

[1] For more information, see National Transportation Safety Board, *Hazardous Materials Release From Railroad Tank Car With Subsequent Fire at Riverside, Michigan, July 14, 2001.* Hazardous Materials Accident Report NTSB/HZM-02/01 (Washington, D.C.: NTSB, 2002).

The Safety Board determined that the probable cause of the accident was a fractured cargo transfer pipe that resulted from (1) the failure of ATOFINA to adequately inspect and maintain its cargo transfer equipment, and (2) inadequate Federal oversight of unloading operations involving hazardous materials. Contributing to the accident was ATOFINA's reliance on a tank car excess flow valve to close in the event of a leak from cargo transfer equipment and the company's failure to require appropriate safety equipment for employees involved in tank car loading and unloading operations.

Metallurgic examination of the failed transfer pipe revealed evidence of erosion-corrosion resulting in a significant thinning of the pipe wall. The flow of the liquefied methyl mercaptan through the pipe caused a gradual erosion of the metal. The erosion was accelerated during each exposure of the interior of the pipe to the weather, when atmospheric corrosion converted small amounts of the steel to iron oxides (rust). Subsequent liquid flow during unloading eroded, or swept away, the iron oxide on the interior of the pipe, revealing clean steel that readily corroded during its next exposure to the atmosphere. The consequence of such cyclic action is the gradual wearing away of the interior surface of the pipe wall, which reduces the strength of the pipe.

During use, the failed pipe was subjected to bending forces by the attachment of an unloading apparatus that weighed about 53 pounds. The Safety Board's metallurgy staff estimated that about 175 pounds of additional downward force applied on the outer end of the apparatus would have resulted in the failure of the pipe; however, this is only an estimate, and the actual force required may have been different. The Safety Board concluded that erosion and corrosion had weakened the transfer pipe such that application of a force such as an individual's falling, leaning, or stepping on the pipe or dropping an object on it, in combination with the weight of the unloading apparatus, could have caused the pipe to break and release the methyl mercaptan.

ATOFINA's Process 46 general operating instructions specified that operators perform a visual, external inspection of transfer piping each time unloading connections were made to a methyl mercaptan tank car. However, external visual inspections would not have detected the reduction in wall thickness caused by the erosion-corrosion that led to the transfer pipe failure in this accident.

ATOFINA's mechanical integrity program included written procedures that covered the inspection and maintenance of all plant equipment used in the handling of hazardous materials, including the transfer pipes used to unload hazardous materials from tank cars. But the inspection procedures under the mechanical integrity program did not establish specific inspection cycles. Instead, the procedures set out subjective and vague inspection standards such as "often" when deterioration is "extreme" and "seldom" when deterioration is "minimal."

While ATOFINA could not provide data or records to confirm whether or when the transfer pipe that failed in this accident had last been inspected under the mechanical integrity program, the erosion-corrosion that was found within the failed pipe indicated that the program had clearly not been effective. The Safety Board concluded that ATOFINA's failure to implement effective procedures for inspection and maintenance of its unloading pipes and fittings allowed the transfer pipe in this accident to gradually deteriorate and ultimately fail.

ATOFINA's procedures at the time of this accident did not require that employees wear self-contained breathing apparatuses (SCBAs) while performing cargo transfer operations on methyl mercaptan tank cars. In fact, ATOFINA's procedure for leak testing the unloading apparatus by having the operator pressurize it with the methyl mercaptan and attempt to detect the odor of this poisonous gas actually required the operator to be unprotected to perform the test. This procedure subjected employees to the risk of injury.

Because methyl mercaptan, like chlorine gas, is toxic by inhalation, the use of approved respiratory protection equipment is appropriate to prevent inhalation exposure that could lead to incapacitation and death. An operator wearing such equipment when the release occurred would not have been incapacitated and would have had time to escape the area and/or respond successfully to the emergency. Even an escape hood with an emergency air supply that can be donned in the event of a sudden and unexpected release of poisonous gas would have provided sufficient oxygen to permit an individual to escape the area in the case of such an emergency. Therefore, the Safety Board concluded that the use of proper personal protective equipment, such as SCBAs or escape hoods, would likely have allowed the employees in this accident to survive the initial release of methyl mercaptan and either safely evacuate the area or close the unloading valve and stop the leak.

Both the EPA and the Occupational Safety and Health Administration (OSHA) required ATOFINA to develop and document safety plans for the Riverview facility that included safeguards intended to reduce the risk and consequences of catastrophic releases of hazardous materials. ATOFINA's risk management plan (mandated by the EPA) and process hazard analysis (mandated by OSHA) included an accident scenario that involved the failure of a flexible hose on the unloading apparatus for a methyl mercaptan tank car—a scenario similar to this accident. Under both plans, ATOFINA indicated that the release of methyl mercaptan would be stopped by the automatic closure of the tank car's excess flow valve. Further, ATOFINA's risk management plans explicitly noted that excess flow valves on the tank car would activate in the event of a pipeline or unloading hose rupture. However, when the transfer pipe failed on July 14, 2001, the excess flow valve on the tank car did not close and stop the release of the methyl mercaptan.

Calculations made by Safety Board engineers and parties to the investigation indicated that the flow rate of methyl mercaptan through the broken transfer piping was insufficient to cause the excess flow valve to close. Excess flow valves are designed to close and stop the release of product from the tank car in the event a tank car valve or fitting is broken or sheared off during transit. Attaching cargo transfer apparatus to a tank car can change product release rates and flow rate characteristics and can prevent the excess flow valve from closing in the event of an emergency. As noted by the Chlorine Institute in its *Chlorine Manual* and by the Safety Board in its investigation of a July 30, 1983, accident at the Formosa Plastics plant in Baton Rouge, Louisiana,[2] tank car excess flow valves are not designed to act as an emergency shutoff device during cargo transfer.[3]

To determine whether reliance upon tank car excess flow valves as safety mechanisms during transfer operations is restricted to ATOFINA or is a broader problem, Safety Board investigators interviewed a sampling of domestic chemical companies. Interviews with personnel responsible for company safety plans revealed that six of nine companies surveyed rely on tank car excess flow valves as a method of stopping or limiting a leak in the transfer equipment. Only one company reported having remotely operated shutoff valves on the unloading piping just outside the tank car dome. (The other two companies did not respond to the Safety Board's inquiry.) Although the Safety Board's sampling was limited, the results suggest that the inappropriate use of tank car excess flow valves may be a widespread practice in the chemical industry.

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[2] National Transportation Safety Board, *Vinyl Chloride Monomer Release From a Railroad Tank Car and Fire, Formosa Plastics Corporation Plant, Baton Rouge, Louisiana, July 30, 1983*, Hazardous Material Accident Report NTSB/HZM-85/08 (Washington, D.C.: NTSB, 1985).

[3] Although excess flow valves are routinely used as safety mechanisms in the piping systems of fixed facilities, those excess flow valves are designed and constructed for specific piping systems and the properties of the material flowing through the pipe.

To address this issue, the Safety Board believes that the EPA should notify all facilities that are required to submit risk management plans to the EPA that tank car excess flow valves cannot be relied upon to stop leaks that occur during tank car loading and unloading operations and that those companies that have included reliance on such valves in their risk management plans should instead identify and implement other measures that will stop the uncontrolled release of product in the event of a transfer line failure during tank car loading or unloading.

As alluded to earlier, several Federal agencies, including Department of Transportation (DOT) modal agencies, the EPA, and OSHA, provide safety oversight for elements of hazardous material bulk container loading and unloading operations. None of these programs provided the level of oversight necessary to prevent the Riverview accident.

The EPA and OSHA each have multiple program responsibilities mandated by several statutes. Under the authority of the Clean Air Act and the Occupational Safety and Health Act, the EPA and OSHA exercise some oversight at chemical plants, which includes oversight of hazardous materials transfer operations involving tank cars, highway cargo tanks, and other bulk containers. However, oversight of hazardous materials cargo transfers is only a minor element of these agencies' chemical plant oversight programs, which are themselves elements of still larger programs.

Also, the number of inspectors each agency has assigned to oversee these operations is limited compared to the number of chemical facilities and plants that fall under the agencies' respective programs. The EPA estimates that its risk management program regulates at least 15,000 facilities within the United States; about 2,800 facilities are in Region V, which covers a five-State area that includes Michigan. The EPA had only three inspectors to oversee its risk management program in Region V, and those personnel had conducted only three inspections between the inception of the program in 1999 and the 2001 Riverview accident.

Because of the scope of its oversight responsibilities, OSHA delegates some of those responsibilities to State agencies. MIOSHA, the Michigan agency that has been delegated to provide OSHA oversight within the State, has only two chemical plant inspectors for the entire State. Since 1993, MIOSHA inspectors have conducted approximately 85 plant inspections. Thus, after more than 8 years, the agency has not been able to inspect all of the 100 facilities that, because of the quantities and types of chemicals they use, were identified in the 1993 OSHA oversight program plan as the highest priority plants.

The inspections that EPA and OSHA inspectors must conduct are complicated and intensive because, according to Federal requirements, each EPA or OSHA inspector is expected to oversee all plant operations for each of the regulated facilities. With a chemical plant the size of ATOFINA, this could mean inspecting more than a dozen processes, each with numerous procedures and employees, and hundreds of pieces of equipment. Each piece of equipment may be subject to as many as 12 different safety requirements. For example, the 1994 MIOSHA audit of the ATOFINA Riverview plant took approximately 960 hours to conduct, yet it covered only 2 of the 14 processes at the facility in depth. In addition, although 35 violations were noted during the audit (including ATOFINA's failure to implement a mechanical integrity program for its plant piping system), MIOSHA conducted no follow-up inspection to ensure that ATOFINA had corrected the cited violations.

The EPA and OSHA oversight programs have additional weaknesses. For instance, although the EPA and OSHA both require each facility to develop a written plan that describes the procedures and mechanisms in place under each safety program, neither agency routinely evaluates the plans to determine the effectiveness or appropriateness of the procedures and mechanisms. Also, other than such reviews as take place during the rare plant inspections, neither agency verifies that the plants comply with the standards identified in their own plans.

The Federal Railroad Administration (FRA) has 50 inspectors to determine compliance with the hazardous materials regulations. Although the single FRA inspector responsible for the State of Michigan has approximately 90 facilities to oversee, he generally has been able to inspect all of those facilities annually. In fact, the FRA has inspected the Riverview plant seven times in the past 6 years. The FRA inspectors are able to perform more frequent inspections than either the EPA or OSHA because, at least in part, FRA inspections focus on the limited requirements relating to tank car loading and unloading that are contained in the hazardous materials regulations. These regulations cover the setting of tank car brakes, the chocking of wheels, the placing of caution signs on the track, and attendance during unloading operations. They do not address the inspection, maintenance, and support of cargo transfer fittings; the development of safe unloading procedures, including leak test procedures for fittings; or the use of personal protection equipment by the operators unloading the tank car.

The Safety Board therefore concluded that effective oversight of hazardous materials loading and unloading operations from tank cars and other bulk containers is not provided by the FRA, the EPA, or OSHA.

As a result of its investigation of the Riverview accident, the National Transportation Safety Board therefore makes the following safety recommendations to the Environmental Protection Agency:

> Assist the U.S. Department of Transportation in developing safety requirements that apply to the loading and unloading of railroad tank cars, highway cargo tanks, and other bulk containers that address personal protection requirements, emergency shutdown measures, and the inspection and maintenance of cargo transfer equipment. (I-02-4)
>
> Notify all facilities that are required to submit risk management plans to the Environmental Protection Agency that tank car excess flow valves cannot be relied upon to stop leaks that occur during tank car loading and unloading operations and that those companies that have included reliance on such valves in their risk management plans should instead identify and implement other measures that will stop the uncontrolled release of product in the event of a transfer line failure during tank car loading or unloading. (R-02-17)

The Safety Board also issued safety recommendations to the U.S. Department of Transportation, the Federal Railroad Administration, and the Occupational Safety and Health Administration. In your response to the safety recommendations in this letter, please refer to Safety Recommendations I-02-4 and R-02-17. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 16, 2002

In reply refer to: I-02-1 and -2

Honorable Norman Y. Mineta
Secretary of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

About 3:45 a.m., eastern daylight time, on July 14, 2001, at the ATOFINA Chemicals, Inc., (ATOFINA) plant in Riverview, Michigan, a pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. About 4:09 a.m., shortly after the Riverview Fire Department chief arrived on scene, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball about 200 feet into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, a poisonous gas that is also an oxidizer. The fire was extinguished about 9:30 a.m. Three plant employees were killed in the accident. There were several other injuries; most of the injured were treated for respiratory symptoms and released. About 2,000 residents were evacuated from their homes for about 10 hours. Two tank cars, railroad track, and plant equipment (including hoses and fittings) were damaged in the fire.[1]

The Safety Board determined that the probable cause of the accident was a fractured cargo transfer pipe that resulted from (1) the failure of ATOFINA to adequately inspect and maintain its cargo transfer equipment, and (2) inadequate Federal oversight of unloading operations involving hazardous materials. Contributing to the accident was ATOFINA's reliance on a tank car excess flow valve to close in the event of a leak from cargo transfer equipment and the company's failure to require appropriate safety equipment for employees involved in tank car loading and unloading operations.

Metallurgic examination of the failed transfer pipe revealed evidence of erosion-corrosion resulting in a significant thinning of the pipe wall. The flow of the liquefied methyl mercaptan through the pipe caused a gradual erosion of the metal. The erosion was accelerated during each exposure of the interior of the pipe to the weather, when atmospheric corrosion converted small amounts of the steel to iron oxides (rust). Subsequent liquid flow during unloading eroded, or swept away, the iron oxide on the interior of the pipe, revealing clean steel that readily corroded during its next exposure to the atmosphere. The consequence of such cyclic action is the gradual wearing away of the interior surface of the pipe wall, which reduces the strength of the pipe.

During use, the failed pipe was subjected to bending forces by the attachment of an unloading apparatus that weighed about 53 pounds. The Safety Board's metallurgy staff estimated that about 175 pounds of additional downward force applied on the outer end of the

[1] For more information, see National Transportation Safety Board, *Hazardous Materials Release From Railroad Tank Car With Subsequent Fire at Riverside, Michigan, July 14, 2001*. Hazardous Materials Accident Report NTSB/HZM-02/01 (Washington, D.C.: NTSB, 2002).

apparatus would have resulted in the failure of the pipe; however, this is only an estimate, and the actual force required may have been different. The Safety Board concluded that erosion and corrosion had weakened the transfer pipe such that application of a force such as an individual's falling, leaning, or stepping on the pipe or dropping an object on it, in combination with the weight of the unloading apparatus, could have caused the pipe to break and release the methyl mercaptan.

ATOFINA's Process 46 general operating instructions specified that operators perform a visual, external inspection of transfer piping each time unloading connections were made to a methyl mercaptan tank car. However, external visual inspections would not have detected the reduction in wall thickness caused by the erosion-corrosion that led to the transfer pipe failure in this accident.

ATOFINA's mechanical integrity program included written procedures that covered the inspection and maintenance of all plant equipment used in the handling of hazardous materials, including the transfer pipes used to unload hazardous materials from tank cars. But the inspection procedures under the mechanical integrity program did not establish specific inspection cycles. Instead, the procedures set out subjective and vague inspection standards such as "often" when deterioration is "extreme" and "seldom" when deterioration is "minimal."

While ATOFINA could not provide data or records to confirm whether or when the transfer pipe that failed in this accident had last been inspected under the mechanical integrity program, the erosion-corrosion that was found within the failed pipe indicated that the program had clearly not been effective. The Safety Board concluded that ATOFINA's failure to implement effective procedures for inspection and maintenance of its unloading pipes and fittings allowed the transfer pipe in this accident to gradually deteriorate and ultimately fail.

ATOFINA's procedures at the time of this accident did not require that employees wear self-contained breathing apparatuses (SCBAs) while performing cargo transfer operations on methyl mercaptan tank cars. In fact, ATOFINA's procedure for leak-testing the unloading apparatus by having the operator pressurize it with the methyl mercaptan and attempt to detect the odor of this poisonous gas actually required the operator to be unprotected to perform the test. This procedure subjected employees to the risk of injury.

Because methyl mercaptan, like chlorine gas, is toxic by inhalation, the use of approved respiratory protection equipment is appropriate to prevent inhalation exposure that could lead to incapacitation and death. An operator wearing such equipment when the release occurred would not have been incapacitated and would have had time to escape the area and/or respond successfully to the emergency. Even an escape hood with an emergency air supply that can be donned in the event of a sudden and unexpected release of poisonous gas would have provided sufficient oxygen to permit an individual to escape the area in the case of such an emergency. Therefore, the Safety Board concluded that the use of proper personal protective equipment, such as SCBAs or escape hoods, would likely have allowed the employees in this accident to survive the initial release of methyl mercaptan and either safely evacuate the area or close the unloading valve and stop the leak.

Both the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) required ATOFINA to develop and document safety plans for the Riverview facility that included safeguards intended to reduce the risk and consequences of catastrophic releases of hazardous materials. ATOFINA's risk management plan (mandated by the EPA) and process hazard analysis (mandated by OSHA) included an accident scenario that involved the failure of a flexible hose on the unloading apparatus for a methyl mercaptan tank car—a scenario similar to this accident. Under both plans, ATOFINA indicated that the release of methyl mercaptan would be stopped by the automatic closure of the tank car's excess flow

valve. Further, ATOFINA's risk management plans explicitly noted that excess flow valves on the tank car would activate in the event of a pipeline or unloading hose rupture. However, when the transfer pipe failed on July 14, 2001, the excess flow valve on the tank car did not close and stop the release of the methyl mercaptan.

Calculations made by Safety Board engineers and parties to the investigation indicated that the flow rate of methyl mercaptan through the broken transfer piping was insufficient to cause the excess flow valve to close. Excess flow valves are designed to close and stop the release of product from the tank car in the event a tank car valve or fitting is broken or sheared off during transit. Attaching cargo transfer apparatus to a tank car can change product release rates and flow rate characteristics and can prevent the excess flow valve from closing in the event of an emergency. As noted by the Chlorine Institute in its *Chlorine Manual* and by the Safety Board in its investigation of a July 30, 1983, accident at the Formosa Plastics plant in Baton Rouge, Louisiana,[2] tank car excess flow valves are not designed to act as an emergency shutoff device during cargo transfer.[3]

To determine whether reliance upon tank car excess flow valves as safety mechanisms during transfer operations is restricted to ATOFINA or is a broader problem, Safety Board investigators interviewed a sampling of domestic chemical companies. Interviews with personnel responsible for company safety plans revealed that six of nine companies surveyed rely on tank car excess flow valves as a method of stopping or limiting a leak in the transfer equipment. Only one company reported having remotely operated shutoff valves on the unloading piping just outside the tank car dome. (The other two companies did not respond to the Safety Board's inquiry.) Although the Safety Board's sampling was limited, the results suggest that the inappropriate use of tank car excess flow valves may be a widespread practice in the chemical industry.

As alluded to earlier, several Federal agencies, including Department of Transportation (DOT) modal agencies, the EPA, and OSHA, provide safety oversight for elements of hazardous material bulk container loading and unloading operations. None of these programs provided the level of oversight necessary to prevent the Riverview accident.

The EPA and OSHA each have multiple program responsibilities mandated by several statutes. Under the authority of the Clean Air Act and the Occupational Safety and Health Act, the EPA and OSHA exercise some oversight at chemical plants, which includes oversight of hazardous materials transfer operations involving tank cars, highway cargo tanks, and other bulk containers. However, oversight of hazardous materials cargo transfers is only a minor element of these agencies' chemical plant oversight programs, which are themselves elements of still larger programs.

Also, the number of inspectors each agency has assigned to oversee these operations is limited compared to the number of chemical facilities and plants that fall under the agencies' respective programs. The EPA estimates that its risk management program regulates at least 15,000 facilities within the United States; about 2,800 facilities are in Region V, which covers a five-State area that includes Michigan. The EPA had only three inspectors to oversee its risk management program in Region V, and those personnel had conducted only three inspections between the inception of the program in 1999 and the 2001 Riverview accident.

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[3] Although excess flow valves are routinely used as safety mechanisms in the piping systems of fixed facilities, those excess flow valves are designed and constructed for specific piping systems and the properties of the material flowing through the pipe.

Because of the scope of its oversight responsibilities, OSHA delegates some of those responsibilities to State agencies. MIOSHA, the Michigan agency that has been delegated to provide OSHA oversight within the State, has only two chemical plant inspectors for the entire State. Since 1993, MIOSHA inspectors have conducted approximately 85 plant inspections. Thus, after more than 8 years, the agency has not been able to inspect all of the 100 facilities that, because of the quantities and types of chemicals they use, were identified in the 1993 OSHA oversight program plan as the highest priority plants.

The inspections that EPA and OSHA inspectors must conduct are complicated and intensive because, according to Federal requirements, each EPA or OSHA inspector is expected to oversee all plant operations for each of the regulated facilities. With a chemical plant the size of ATOFINA, this could mean inspecting more than a dozen processes, each with numerous procedures and employees, and hundreds of pieces of equipment. Each piece of equipment may be subject to as many as 12 different safety requirements. For example, the 1994 MIOSHA audit of the ATOFINA Riverview plant took approximately 960 hours to conduct, yet it covered only 2 of the 14 processes at the facility in depth. In addition, although 35 violations were noted during the audit (including ATOFINA's failure to implement a mechanical integrity program for its plant piping system), MIOSHA conducted no follow-up inspection to ensure that ATOFINA had corrected the cited violations.

The EPA and OSHA oversight programs have additional weaknesses. For instance, although the EPA and OSHA both require each facility to develop a written plan that describes the procedures and mechanisms in place under each safety program, neither agency routinely evaluates the plans to determine the effectiveness or appropriateness of the procedures and mechanisms. Also, other than such reviews as take place during the rare plant inspections, neither agency verifies that the plants comply with the standards identified in their own plans.

The Federal Railroad Administration (FRA) has 50 inspectors to determine compliance with the hazardous materials regulations. Although the single FRA inspector responsible for the State of Michigan has approximately 90 facilities to oversee, he generally has been able to inspect all of those facilities annually. In fact, the FRA has inspected the Riverview plant seven times in the past 6 years. The FRA inspectors are able to perform more frequent inspections than either the EPA or OSHA because, at least in part, FRA inspections focus on the limited requirements relating to tank car loading and unloading that are contained in the hazardous materials regulations. These regulations cover the setting of tank car brakes, the chocking of wheels, the placing of caution signs on the track, and attendance during unloading operations. They do not address the inspection, maintenance, and support of cargo transfer fittings; the development of safe unloading procedures, including leak-test procedures for fittings; or the use of personal protection equipment by the operators unloading the tank car.

The Safety Board therefore concluded that effective oversight of hazardous materials loading and unloading operations from tank cars and other bulk containers is not provided by the FRA, the EPA, or OSHA.

Over a number of years, the Safety Board has attempted to address the safety problems associated with hazardous materials loading and unloading operations from bulk containers by making individual recommendations to the various Federal agencies—including the EPA, OSHA, the FRA, the Research and Special Programs Administration (RSPA), and the DOT—that share elements of the responsibility for providing safety oversight of these operations.

For example, many of the deficiencies with Federal oversight identified during this investigation are almost identical to the safety issues the Safety Board noted in its report on the previously referenced 1983 accident at the Formosa Plastics plant in Baton Rouge, Louisiana. That accident involved the release and ignition of a toxic gas from a tank car during transfer

operations at a petrochemical facility. As a result of its investigation, the Safety Board concluded that contributing to the accident was the fact that Federal regulations concerning working conditions and the equipment used at the transfer station were not being enforced at the plant because neither the FRA nor OSHA had inspected the plant between 1977 and 1983.

Other accidents, including the October 7, 1986, fire on board the Panamanian tank ship *Shoun Vanguard* in Deer Park, Texas,[4] and the March 6, 1984, release of hazardous waste acid from a cargo tank truck in Orange County, Florida,[5] heightened the Safety Board's concerns about the transfer of hazardous materials between and within all modes of transportation. Because this concern involved several modes of transportation, the Safety Board issued the following intermodal safety recommendation on March 14, 1988, to the DOT:

> I-88-2
> Strengthen minimum safety requirements for loading and unloading of hazardous materials to provide adequate, uniform safety in all modes of transportation.

In a September 30, 1988, response, the DOT stated that it was examining issues related to the loading and unloading of hazardous materials at intermodal facilities through several rulemaking activities, but the DOT did not complete action on most of these initiatives. After the Safety Board requested an update on the status of its actions, the DOT indicated in a September 2000 response that it had focused primarily on a proposed rule under docket HM-223 that would be published within the upcoming fiscal year (FY 2001). According to the DOT, HM-223 would address the applicability of the hazardous materials regulations to loading, unloading, and storage. The DOT stated that the goal of the rulemaking under HM-223 was to "clarify" the applicability of the hazardous materials regulations and the jurisdictional relationship between the hazardous materials regulations and regulations promulgated by the EPA and OSHA. On December 5, 2000, the Safety Board determined that, although the DOT was undertaking a strategic realignment of the management of the department's hazardous materials program, there had not been any significant progress on the recommendation in more than 12 years. Consequently, the Safety Board classified Safety Recommendation I-88-2 "Closed—Unacceptable Action."

On June 14, 2001, RSPA published its NPRM under docket HM-223, *Applicability of Hazardous Materials Regulations to Loading, Unloading, and Storage*. Under the rulemaking, RSPA proposed to limit the definition of "transportation" to include only the period from the moment a carrier accepts a container or package of hazardous materials until the carrier relinquishes it to the consignee. The proposed rule would thus apply to loading and unloading operations only if those operations are performed by the carrier. The Safety Board is concerned that, because the loading of tank cars and other bulk containers is typically performed by the offeror before the carrier accepts the vehicle or bulk container and because unloading is frequently performed by the consignee after the carrier relinquishes it, these operations would, in most cases, not be covered by the regulations or be subject to DOT oversight. The Safety Board's October 29, 2001, letter to RSPA concerning the NPRM expressed these concerns in detail.

The National Transportation Safety Board therefore makes the following safety recommendations to the Department of Transportation:

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[4] National Transportation Safety Board, *Fires on Board the Panamanian Tank Ship* Shoun Vanguard *and the U.S. Tank Barge* Hollywood 3013, *Deer Park, Texas, October 7, 1986,* Marine Accident Report NTSB/MAR-87/08 (Washington, D.C.: NTSB, 1987).

[5] National Transportation Safety Board, *Release of Hazardous Waste Acid from Cargo Tank Truck, Orange County, Florida, March 6, 1984*, Hazardous Materials Accident Summary Report NTSB/HZM-85/01 (Washington, D.C.: NTSB, 1985).

Develop, with the assistance of the Environmental Protection Agency and Occupational Safety and Health Administration, safety requirements that apply to the loading and unloading of railroad tank cars, highway cargo tanks, and other bulk containers that address the inspection and maintenance of cargo transfer equipment, emergency shutdown measures, and personal protection requirements. (I-02-1)

Implement, after the adoption of safety requirements developed in response to Safety Recommendation I-02-1, an oversight program to ensure compliance with these requirements. (I-02-2)

The Safety Board also issued safety recommendations to the Federal Railroad Administration, the Environmental Protection Agency, and the Occupational Safety and Health Administration.

Please refer to Safety Recommendations I-02-1 and -2 in your reply. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 16, 2002

In reply refer to: I-02-3

Honorable John L. Henshaw
Assistant Secretary of Labor for
Occupational Safety and Health
Occupational Safety and Health Administration
200 Constitution Ave., N.W., Room S2315
Washington, D.C. 20210

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the adequacy of Federal regulations and oversight for cargo transfer operations involving bulk containers transporting hazardous materials. The recommendation is derived from the Safety Board's investigation of the July 14, 2001, hazardous materials accident at the ATOFINA Chemicals, Inc., (ATOFINA) plant in Riverview, Michigan, and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued six safety recommendations, one of which is addressed to the Occupational Safety and Health Administration (OSHA). Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

About 3:45 a.m., eastern daylight time, on July 14, 2001, at the ATOFINA plant in Riverview, Michigan, a pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. About 4:09 a.m., shortly after the Riverview Fire Department chief arrived on scene, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball about 200 feet into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, a poisonous gas that is also an oxidizer. The fire was extinguished about 9:30 a.m. Three plant employees were killed in the accident. There were several other injuries; most of the injured were treated for respiratory symptoms and released. About 2,000 residents were evacuated from their homes for about 10 hours. Two tank cars, railroad track, and plant equipment (including hoses and fittings) were damaged in the fire.[1]

The Safety Board determined that the probable cause of the accident was a fractured cargo transfer pipe that resulted from (1) the failure of ATOFINA to adequately inspect and

[1] For more information, see National Transportation Safety Board, *Hazardous Materials Release From Railroad Tank Car With Subsequent Fire at Riverside, Michigan, July 14, 2001.* Hazardous Materials Accident Report NTSB/HZM-02/01 (Washington, D.C.: NTSB, 2002).

maintain its cargo transfer equipment, and (2) inadequate Federal oversight of unloading operations involving hazardous materials. Contributing to the accident was ATOFINA's reliance on a tank car excess flow valve to close in the event of a leak from cargo transfer equipment and the company's failure to require appropriate safety equipment for employees involved in tank car loading and unloading operations.

Metallurgic examination of the failed transfer pipe revealed evidence of erosion-corrosion resulting in a significant thinning of the pipe wall. The flow of the liquefied methyl mercaptan through the pipe caused a gradual erosion of the metal. The erosion was accelerated during each exposure of the interior of the pipe to the weather, when atmospheric corrosion converted small amounts of the steel to iron oxides (rust). Subsequent liquid flow during unloading eroded, or swept away, the iron oxide on the interior of the pipe, revealing clean steel that readily corroded during its next exposure to the atmosphere. The consequence of such cyclic action is the gradual wearing away of the interior surface of the pipe wall, which reduces the strength of the pipe.

During use, the failed pipe was subjected to bending forces by the attachment of an unloading apparatus that weighed about 53 pounds. The Safety Board's metallurgy staff estimated that about 175 pounds of additional downward force applied on the outer end of the apparatus would have resulted in the failure of the pipe; however, this is only an estimate, and the actual force required may have been different. The Safety Board concluded that erosion and corrosion had weakened the transfer pipe such that application of a force such as an individual's falling, leaning, or stepping on the pipe or dropping an object on it, in combination with the weight of the unloading apparatus, could have caused the pipe to break and release the methyl mercaptan.

ATOFINA's Process 46 general operating instructions specified that operators perform a visual, external inspection of transfer piping each time unloading connections were made to a methyl mercaptan tank car. However, external visual inspections would not have detected the reduction in wall thickness caused by the erosion-corrosion that led to the transfer pipe failure in this accident.

ATOFINA's mechanical integrity program included written procedures that covered the inspection and maintenance of all plant equipment used in the handling of hazardous materials, including the transfer pipes used to unload hazardous materials from tank cars. But the inspection procedures under the mechanical integrity program did not establish specific inspection cycles. Instead, the procedures set out subjective and vague inspection standards such as "often" when deterioration is "extreme" and "seldom" when deterioration is "minimal."

While ATOFINA could not provide data or records to confirm whether or when the transfer pipe that failed in this accident had last been inspected under the mechanical integrity program, the erosion-corrosion that was found within the failed pipe indicated that the program had clearly not been effective. The Safety Board concluded that ATOFINA's failure to implement effective procedures for inspection and maintenance of its unloading pipes and fittings allowed the transfer pipe in this accident to gradually deteriorate and ultimately fail.

ATOFINA's procedures at the time of this accident did not require that employees wear self-contained breathing apparatuses (SCBAs) while performing cargo transfer operations on methyl mercaptan tank cars. In fact, ATOFINA's procedure for leak testing the unloading apparatus by having the operator pressurize it with the methyl mercaptan and attempt to detect the odor of this poisonous gas actually required the operator to be unprotected to perform the test. This procedure subjected employees to the risk of injury.

Because methyl mercaptan, like chlorine gas, is toxic by inhalation, the use of approved respiratory protection equipment is appropriate to prevent inhalation exposure that could lead to incapacitation and death. An operator wearing such equipment when the release occurred would not have been incapacitated and would have had time to escape the area and/or respond successfully to the emergency. Even an escape hood with an emergency air supply that can be donned in the event of a sudden and unexpected release of poisonous gas would have provided sufficient oxygen to permit an individual to escape the area in the case of such an emergency. Therefore, the Safety Board concluded that the use of proper personal protective equipment, such as SCBAs or escape hoods, would likely have allowed the employees in this accident to survive the initial release of methyl mercaptan and either safely evacuate the area or close the unloading valve and stop the leak.

Both OSHA and the Environmental Protection Agency (EPA) required ATOFINA to develop and document safety plans for the Riverview facility that included safeguards intended to reduce the risk and consequences of catastrophic releases of hazardous materials. ATOFINA's risk management plan (mandated by the EPA) and process hazard analysis (mandated by OSHA) included an accident scenario that involved the failure of a flexible hose on the unloading apparatus for a methyl mercaptan tank car—a scenario similar to this accident. Under both plans, ATOFINA indicated that the release of methyl mercaptan would be stopped by the automatic closure of the tank car's excess flow valve. Further, ATOFINA's risk management plans explicitly noted that excess flow valves on the tank car would activate in the event of a pipeline or unloading hose rupture. However, when the transfer pipe failed on July 14, 2001, the excess flow valve on the tank car did not close and stop the release of the methyl mercaptan.

Calculations made by Safety Board engineers and parties to the investigation indicated that the flow rate of methyl mercaptan through the broken transfer piping was insufficient to cause the excess flow valve to close. Excess flow valves are designed to close and stop the release of product from the tank car in the event a tank car valve or fitting is broken or sheared off during transit. Attaching cargo transfer apparatus to a tank car can change product release rates and flow rate characteristics and can prevent the excess flow valve from closing in the event of an emergency. As noted by the Chlorine Institute in its *Chlorine Manual* and by the Safety Board in its investigation of a July 30, 1983, accident at the Formosa Plastics plant in Baton Rouge, Louisiana,[2] tank car excess flow valves are not designed to act as an emergency shutoff device during cargo transfer.[3]

To determine whether reliance upon tank car excess flow valves as safety mechanisms during transfer operations is restricted to ATOFINA or is a broader problem, Safety Board investigators interviewed a sampling of domestic chemical companies. Interviews with personnel responsible for company safety plans revealed that six of nine companies surveyed rely on tank car excess flow valves as a method of stopping or limiting a leak in the transfer equipment. Only one company reported having remotely operated shutoff valves on the unloading piping just outside the tank car dome. (The other two companies did not respond to the Safety Board's inquiry.) Although the Safety Board's sampling was limited, the results suggest that the inappropriate use of tank car excess flow valves may be a widespread practice in the chemical industry.

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[2] National Transportation Safety Board, *Vinyl Chloride Monomer Release From a Railroad Tank Car and Fire, Formosa Plastics Corporation Plant, Baton Rouge, Louisiana, July 30, 1983*, Hazardous Material Accident Report NTSB/HZM-85/08 (Washington, D.C.: NTSB, 1985).

[3] Although excess flow valves are routinely used as safety mechanisms in the piping systems of fixed facilities, those excess flow valves are designed and constructed for specific piping systems and the properties of the material flowing through the pipe.

As alluded to earlier, several Federal agencies, including Department of Transportation (DOT) modal agencies, the EPA, and OSHA, provide safety oversight for elements of hazardous material bulk container loading and unloading operations. None of these programs provided the level of oversight necessary to prevent the Riverview accident.

The EPA and OSHA each have multiple program responsibilities mandated by several statutes. Under the authority of the Clean Air Act and the Occupational Safety and Health Act, the EPA and OSHA exercise some oversight at chemical plants, which includes oversight of hazardous materials transfer operations involving tank cars, highway cargo tanks, and other bulk containers. However, oversight of hazardous materials cargo transfers is only a minor element of these agencies' chemical plant oversight programs, which are themselves elements of still larger programs.

Also, the number of inspectors each agency has assigned to oversee these operations is limited compared to the number of chemical facilities and plants that fall under the agencies' respective programs. The EPA estimates that its risk management program regulates at least 15,000 facilities within the United States; about 2,800 facilities are in Region V, which covers a five-State area that includes Michigan. The EPA had only three inspectors to oversee its risk management program in Region V, and those personnel had conducted only three inspections between the inception of the program in 1999 and the 2001 Riverview accident.

Because of the scope of its oversight responsibilities, OSHA delegates some of those responsibilities to State agencies. MIOSHA, the Michigan agency that has been delegated to provide OSHA oversight within the State, has only two chemical plant inspectors for the entire State. Since 1993, MIOSHA inspectors have conducted approximately 85 plant inspections. Thus, after more than 8 years, the agency has not been able to inspect all of the 100 facilities that, because of the quantities and types of chemicals they use, were identified in the 1993 OSHA oversight program plan as the highest priority plants.

The inspections that EPA and OSHA inspectors must conduct are complicated and intensive because, according to Federal requirements, each EPA or OSHA inspector is expected to oversee all plant operations for each of the regulated facilities. With a chemical plant the size of ATOFINA, this could mean inspecting more than a dozen processes, each with numerous procedures and employees, and hundreds of pieces of equipment. Each piece of equipment may be subject to as many as 12 different safety requirements. For example, the 1994 MIOSHA audit of the ATOFINA Riverview plant took approximately 960 hours to conduct, yet it covered only 2 of the 14 processes at the facility in depth. In addition, although 35 violations were noted during the audit (including ATOFINA's failure to implement a mechanical integrity program for its plant piping system), MIOSHA conducted no follow-up inspection to ensure that ATOFINA had corrected the cited violations.

The EPA and OSHA oversight programs have additional weaknesses. For instance, although the EPA and OSHA both require each facility to develop a written plan that describes the procedures and mechanisms in place under each safety program, neither agency routinely evaluates the plans to determine the effectiveness or appropriateness of the procedures and mechanisms. Also, other than such reviews as take place during the rare plant inspections, neither agency verifies that the plants comply with the standards identified in their own plans.

The Federal Railroad Administration (FRA) has 50 inspectors to determine compliance with the hazardous materials regulations. Although the single FRA inspector responsible for the State of Michigan has approximately 90 facilities to oversee, he generally has been able to inspect all of those facilities annually. In fact, the FRA has inspected the Riverview plant seven times in the past 6 years. The FRA inspectors are able to perform more frequent inspections than either the EPA or OSHA because, at least in part, FRA inspections focus on the limited

requirements relating to tank car loading and unloading that are contained in the hazardous materials regulations. These regulations cover the setting of tank car brakes, the chocking of wheels, the placing of caution signs on the track, and attendance during unloading operations. They do not address the inspection, maintenance, and support of cargo transfer fittings; the development of safe unloading procedures, including leak test procedures for fittings; or the use of personal protection equipment by the operators unloading the tank car.

The Safety Board therefore concluded that effective oversight of hazardous materials loading and unloading operations from tank cars and other bulk containers is not provided by the FRA, the EPA, or OSHA.

As a result of its investigation of the Riverview accident, the National Transportation Safety Board therefore makes the following safety recommendation to the Occupational Safety and Health Administration:

> Assist the U.S. Department of Transportation in developing safety requirements that apply to the loading and unloading of railroad tank cars, highway cargo tanks, and other bulk containers that address personal protection requirements, emergency shutdown measures, and the inspection and maintenance of cargo transfer equipment. (I-02-3)

The Safety Board also issued safety recommendations to the U.S. Department of Transportation, the Federal Railroad Administration, and the Environmental Protection Agency. In your response to the safety recommendation in this letter, please refer to Safety Recommendation I-02-3. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 16, 2002

In reply refer to: I-02-4 and R-02-17

Honorable Christine Whitman
Administrator
U.S. Environmental Protection Agency
Ariel Rios Building, Room 3000
1200 Pennsylvania Avenue
Washington DC 20460

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the adequacy of Federal regulations and oversight for cargo transfer operations involving bulk containers transporting hazardous materials. The recommendation is derived from the Safety Board's investigation of the July 14, 2001, hazardous materials accident at the ATOFINA Chemicals, Inc., (ATOFINA) plant in Riverview, Michigan, and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued six safety recommendations, two of which are addressed to the Environmental Protection Agency (EPA). Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

About 3:45 a.m., eastern daylight time, on July 14, 2001, at the ATOFINA plant in Riverview, Michigan, a pipe attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. About 4:09 a.m., shortly after the Riverview Fire Department chief arrived on scene, the methyl mercaptan ignited, engulfing the tank car in flames and sending a fireball about 200 feet into the air. Fire damage to cargo transfer hoses on an adjacent tank car resulted in the release of chlorine, a poisonous gas that is also an oxidizer. The fire was extinguished about 9:30 a.m. Three plant employees were killed in the accident. There were several other injuries; most of the injured were treated for respiratory symptoms and released. About 2,000 residents were evacuated from their homes for about 10 hours. Two tank cars, railroad track, and plant equipment (including hoses and fittings) were damaged in the fire.[1]

[1] For more information, see National Transportation Safety Board, *Hazardous Materials Release From Railroad Tank Car With Subsequent Fire at Riverside, Michigan, July 14, 2001.* Hazardous Materials Accident Report NTSB/HZM-02/01 (Washington, D.C.: NTSB, 2002).

The Safety Board determined that the probable cause of the accident was a fractured cargo transfer pipe that resulted from (1) the failure of ATOFINA to adequately inspect and maintain its cargo transfer equipment, and (2) inadequate Federal oversight of unloading operations involving hazardous materials. Contributing to the accident was ATOFINA's reliance on a tank car excess flow valve to close in the event of a leak from cargo transfer equipment and the company's failure to require appropriate safety equipment for employees involved in tank car loading and unloading operations.

Metallurgic examination of the failed transfer pipe revealed evidence of erosion-corrosion resulting in a significant thinning of the pipe wall. The flow of the liquefied methyl mercaptan through the pipe caused a gradual erosion of the metal. The erosion was accelerated during each exposure of the interior of the pipe to the weather, when atmospheric corrosion converted small amounts of the steel to iron oxides (rust). Subsequent liquid flow during unloading eroded, or swept away, the iron oxide on the interior of the pipe, revealing clean steel that readily corroded during its next exposure to the atmosphere. The consequence of such cyclic action is the gradual wearing away of the interior surface of the pipe wall, which reduces the strength of the pipe.

During use, the failed pipe was subjected to bending forces by the attachment of an unloading apparatus that weighed about 53 pounds. The Safety Board's metallurgy staff estimated that about 175 pounds of additional downward force applied on the outer end of the apparatus would have resulted in the failure of the pipe; however, this is only an estimate, and the actual force required may have been different. The Safety Board concluded that erosion and corrosion had weakened the transfer pipe such that application of a force such as an individual's falling, leaning, or stepping on the pipe or dropping an object on it, in combination with the weight of the unloading apparatus, could have caused the pipe to break and release the methyl mercaptan.

ATOFINA's Process 46 general operating instructions specified that operators perform a visual, external inspection of transfer piping each time unloading connections were made to a methyl mercaptan tank car. However, external visual inspections would not have detected the reduction in wall thickness caused by the erosion-corrosion that led to the transfer pipe failure in this accident.

ATOFINA's mechanical integrity program included written procedures that covered the inspection and maintenance of all plant equipment used in the handling of hazardous materials, including the transfer pipes used to unload hazardous materials from tank cars. But the inspection procedures under the mechanical integrity program did not establish specific inspection cycles. Instead, the procedures set out subjective and vague inspection standards such as "often" when deterioration is "extreme" and "seldom" when deterioration is "minimal."

While ATOFINA could not provide data or records to confirm whether or when the transfer pipe that failed in this accident had last been inspected under the mechanical integrity program, the erosion-corrosion that was found within the failed pipe indicated that the program had clearly not been effective. The Safety Board concluded that ATOFINA's failure to implement effective procedures for inspection and maintenance of its unloading pipes and fittings allowed the transfer pipe in this accident to gradually deteriorate and ultimately fail.

ATOFINA's procedures at the time of this accident did not require that employees wear self-contained breathing apparatuses (SCBAs) while performing cargo transfer operations on methyl mercaptan tank cars. In fact, ATOFINA's procedure for leak testing the unloading apparatus by having the operator pressurize it with the methyl mercaptan and attempt to detect the odor of this poisonous gas actually required the operator to be unprotected to perform the test. This procedure subjected employees to the risk of injury.

Because methyl mercaptan, like chlorine gas, is toxic by inhalation, the use of approved respiratory protection equipment is appropriate to prevent inhalation exposure that could lead to incapacitation and death. An operator wearing such equipment when the release occurred would not have been incapacitated and would have had time to escape the area and/or respond successfully to the emergency. Even an escape hood with an emergency air supply that can be donned in the event of a sudden and unexpected release of poisonous gas would have provided sufficient oxygen to permit an individual to escape the area in the case of such an emergency. Therefore, the Safety Board concluded that the use of proper personal protective equipment, such as SCBAs or escape hoods, would likely have allowed the employees in this accident to survive the initial release of methyl mercaptan and either safely evacuate the area or close the unloading valve and stop the leak.

Both the EPA and the Occupational Safety and Health Administration (OSHA) required ATOFINA to develop and document safety plans for the Riverview facility that included safeguards intended to reduce the risk and consequences of catastrophic releases of hazardous materials. ATOFINA's risk management plan (mandated by the EPA) and process hazard analysis (mandated by OSHA) included an accident scenario that involved the failure of a flexible hose on the unloading apparatus for a methyl mercaptan tank car—a scenario similar to this accident. Under both plans, ATOFINA indicated that the release of methyl mercaptan would be stopped by the automatic closure of the tank car's excess flow valve. Further, ATOFINA's risk management plans explicitly noted that excess flow valves on the tank car would activate in the event of a pipeline or unloading hose rupture. However, when the transfer pipe failed on July 14, 2001, the excess flow valve on the tank car did not close and stop the release of the methyl mercaptan.

Calculations made by Safety Board engineers and parties to the investigation indicated that the flow rate of methyl mercaptan through the broken transfer piping was insufficient to cause the excess flow valve to close. Excess flow valves are designed to close and stop the release of product from the tank car in the event a tank car valve or fitting is broken or sheared off during transit. Attaching cargo transfer apparatus to a tank car can change product release rates and flow rate characteristics and can prevent the excess flow valve from closing in the event of an emergency. As noted by the Chlorine Institute in its *Chlorine Manual* and by the Safety Board in its investigation of a July 30, 1983, accident at the Formosa Plastics plant in Baton Rouge, Louisiana,[2] tank car excess flow valves are not designed to act as an emergency shutoff device during cargo transfer.[3]

To determine whether reliance upon tank car excess flow valves as safety mechanisms during transfer operations is restricted to ATOFINA or is a broader problem, Safety Board investigators interviewed a sampling of domestic chemical companies. Interviews with personnel responsible for company safety plans revealed that six of nine companies surveyed rely on tank car excess flow valves as a method of stopping or limiting a leak in the transfer equipment. Only one company reported having remotely operated shutoff valves on the unloading piping just outside the tank car dome. (The other two companies did not respond to the Safety Board's inquiry.) Although the Safety Board's sampling was limited, the results suggest that the inappropriate use of tank car excess flow valves may be a widespread practice in the chemical industry.

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[2] National Transportation Safety Board, *Vinyl Chloride Monomer Release From a Railroad Tank Car and Fire, Formosa Plastics Corporation Plant, Baton Rouge, Louisiana, July 30, 1983*, Hazardous Material Accident Report NTSB/HZM-85/08 (Washington, D.C.: NTSB, 1985).

[3] Although excess flow valves are routinely used as safety mechanisms in the piping systems of fixed facilities, those excess flow valves are designed and constructed for specific piping systems and the properties of the material flowing through the pipe.

To address this issue, the Safety Board believes that the EPA should notify all facilities that are required to submit risk management plans to the EPA that tank car excess flow valves cannot be relied upon to stop leaks that occur during tank car loading and unloading operations and that those companies that have included reliance on such valves in their risk management plans should instead identify and implement other measures that will stop the uncontrolled release of product in the event of a transfer line failure during tank car loading or unloading.

As alluded to earlier, several Federal agencies, including Department of Transportation (DOT) modal agencies, the EPA, and OSHA, provide safety oversight for elements of hazardous material bulk container loading and unloading operations. None of these programs provided the level of oversight necessary to prevent the Riverview accident.

The EPA and OSHA each have multiple program responsibilities mandated by several statutes. Under the authority of the Clean Air Act and the Occupational Safety and Health Act, the EPA and OSHA exercise some oversight at chemical plants, which includes oversight of hazardous materials transfer operations involving tank cars, highway cargo tanks, and other bulk containers. However, oversight of hazardous materials cargo transfers is only a minor element of these agencies' chemical plant oversight programs, which are themselves elements of still larger programs.

Also, the number of inspectors each agency has assigned to oversee these operations is limited compared to the number of chemical facilities and plants that fall under the agencies' respective programs. The EPA estimates that its risk management program regulates at least 15,000 facilities within the United States; about 2,800 facilities are in Region V, which covers a five-State area that includes Michigan. The EPA had only three inspectors to oversee its risk management program in Region V, and those personnel had conducted only three inspections between the inception of the program in 1999 and the 2001 Riverview accident.

Because of the scope of its oversight responsibilities, OSHA delegates some of those responsibilities to State agencies. MIOSHA, the Michigan agency that has been delegated to provide OSHA oversight within the State, has only two chemical plant inspectors for the entire State. Since 1993, MIOSHA inspectors have conducted approximately 85 plant inspections. Thus, after more than 8 years, the agency has not been able to inspect all of the 100 facilities that, because of the quantities and types of chemicals they use, were identified in the 1993 OSHA oversight program plan as the highest priority plants.

The inspections that EPA and OSHA inspectors must conduct are complicated and intensive because, according to Federal requirements, each EPA or OSHA inspector is expected to oversee all plant operations for each of the regulated facilities. With a chemical plant the size of ATOFINA, this could mean inspecting more than a dozen processes, each with numerous procedures and employees, and hundreds of pieces of equipment. Each piece of equipment may be subject to as many as 12 different safety requirements. For example, the 1994 MIOSHA audit of the ATOFINA Riverview plant took approximately 960 hours to conduct, yet it covered only 2 of the 14 processes at the facility in depth. In addition, although 35 violations were noted during the audit (including ATOFINA's failure to implement a mechanical integrity program for its plant piping system), MIOSHA conducted no follow-up inspection to ensure that ATOFINA had corrected the cited violations.

The EPA and OSHA oversight programs have additional weaknesses. For instance, although the EPA and OSHA both require each facility to develop a written plan that describes the procedures and mechanisms in place under each safety program, neither agency routinely evaluates the plans to determine the effectiveness or appropriateness of the procedures and mechanisms. Also, other than such reviews as take place during the rare plant inspections, neither agency verifies that the plants comply with the standards identified in their own plans.

The Federal Railroad Administration (FRA) has 50 inspectors to determine compliance with the hazardous materials regulations. Although the single FRA inspector responsible for the State of Michigan has approximately 90 facilities to oversee, he generally has been able to inspect all of those facilities annually. In fact, the FRA has inspected the Riverview plant seven times in the past 6 years. The FRA inspectors are able to perform more frequent inspections than either the EPA or OSHA because, at least in part, FRA inspections focus on the limited requirements relating to tank car loading and unloading that are contained in the hazardous materials regulations. These regulations cover the setting of tank car brakes, the chocking of wheels, the placing of caution signs on the track, and attendance during unloading operations. They do not address the inspection, maintenance, and support of cargo transfer fittings; the development of safe unloading procedures, including leak test procedures for fittings; or the use of personal protection equipment by the operators unloading the tank car.

The Safety Board therefore concluded that effective oversight of hazardous materials loading and unloading operations from tank cars and other bulk containers is not provided by the FRA, the EPA, or OSHA.

As a result of its investigation of the Riverview accident, the National Transportation Safety Board therefore makes the following safety recommendations to the Environmental Protection Agency:

> Assist the U.S. Department of Transportation in developing safety requirements that apply to the loading and unloading of railroad tank cars, highway cargo tanks, and other bulk containers that address personal protection requirements, emergency shutdown measures, and the inspection and maintenance of cargo transfer equipment. (I-02-4)
>
> Notify all facilities that are required to submit risk management plans to the Environmental Protection Agency that tank car excess flow valves cannot be relied upon to stop leaks that occur during tank car loading and unloading operations and that those companies that have included reliance on such valves in their risk management plans should instead identify and implement other measures that will stop the uncontrolled release of product in the event of a transfer line failure during tank car loading or unloading. (R-02-17)

The Safety Board also issued safety recommendations to the U.S. Department of Transportation, the Federal Railroad Administration, and the Occupational Safety and Health Administration. In your response to the safety recommendations in this letter, please refer to Safety Recommendations I-02-4 and R-02-17. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 22, 2002

In reply refer to: A-02-15 through -19

Honorable Jane Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 16, 2000, about 1548 eastern standard time (EST), an F-16 fighter operated by the U.S. Air Force (USAF) with the call sign "Ninja2" was involved in a midair collision with a Cessna 172, N73829, near Bradenton, Florida. Ninja2 was the second aircraft in a formation flight of two F-16s (along with the flight leader, whose call sign was "Ninja1")[1] that was on a low-altitude military training mission. N73829 was conducting a personal flight under 14 *Code of Federal Regulations* (CFR) Part 91. Both aircraft were destroyed. The pilot of N73829 was killed, and the pilot of Ninja2 sustained minor injuries while ejecting from the F-16. All three aircraft were operating under visual flight rules (VFR) at the time of the accident. Although the National Transportation Safety Board's investigation is ongoing,[2] preliminary findings have revealed safety issues that warrant the Federal Aviation Administration's (FAA) attention.

Background

About 1513, Ninja1 departed from Moody Air Force Base (AFB), Valdosta, Georgia, en route to the entry point for visual route (VR)-1098.[3] Ninja1 was assigned a block altitude of between flight level (FL) 250[4] and 260 by the Miami Air Route Traffic Control Center (ARTCC), in accordance with instrument flight rules (IFR).[5] Aircraft flying formation flights are usually required to be within 1 mile of each other throughout the flight and are handled as a single aircraft by air traffic control (ATC). As Ninja1 approached the SRQ area, the Miami ARTCC controller cleared the flight to descend to 13,000 feet. At 1543:25, Miami ARTCC informed the Tampa Terminal Radar Approach Control (TRACON) controllers that Ninja1 was "descending into some VR route." At 1543:39, the Miami ARTCC controller instructed Ninja1

[1] Unless otherwise indicated, the term, "Ninja1," is used throughout the document to refer to the formation flight.

[2] The description of this accident, MIA01FA028A, can be found on the Safety Board's Web site at <http://www.ntsb.gov>.

[3] VR-1098 is a low-level military training route (MTR) that begins about 12 miles northeast of the Sarasota Bradenton International Airport (SRQ), Sarasota, Florida. The altitude for the entry point and initial segment of the route is 500 to 1,500 feet above ground level, and its width is 5 miles left of centerline to 3 miles right of centerline.

[4] FL 250 is 25,000 feet mean sea level (msl), based on an altimeter setting of 29.92 inches of mercury.

[5] A composite military IFR/VFR flight plan had been filed for Ninja1.

to contact Tampa TRACON for further services.[6] However, the pilot of Ninja1 was given an incorrect frequency; therefore, he was unable to contact Tampa TRACON.

At 1544:34, after trying, unsuccessfully, to contact Tampa TRACON several times, the pilot of Ninja1 reestablished contact with Miami ARTCC and informed the controller that he wished to cancel his IFR flight plan. The controller accepted the cancellation and asked the pilot if he wished to continue receiving radar traffic advisory services. The pilot declined. The controller instructed Ninja1 to set code 1200 (standard for visual operations) in the aircraft's radar transponder and terminated radar traffic advisory services. Ninja1 then began a VFR descent to enter VR-1098. (See figure 1.)

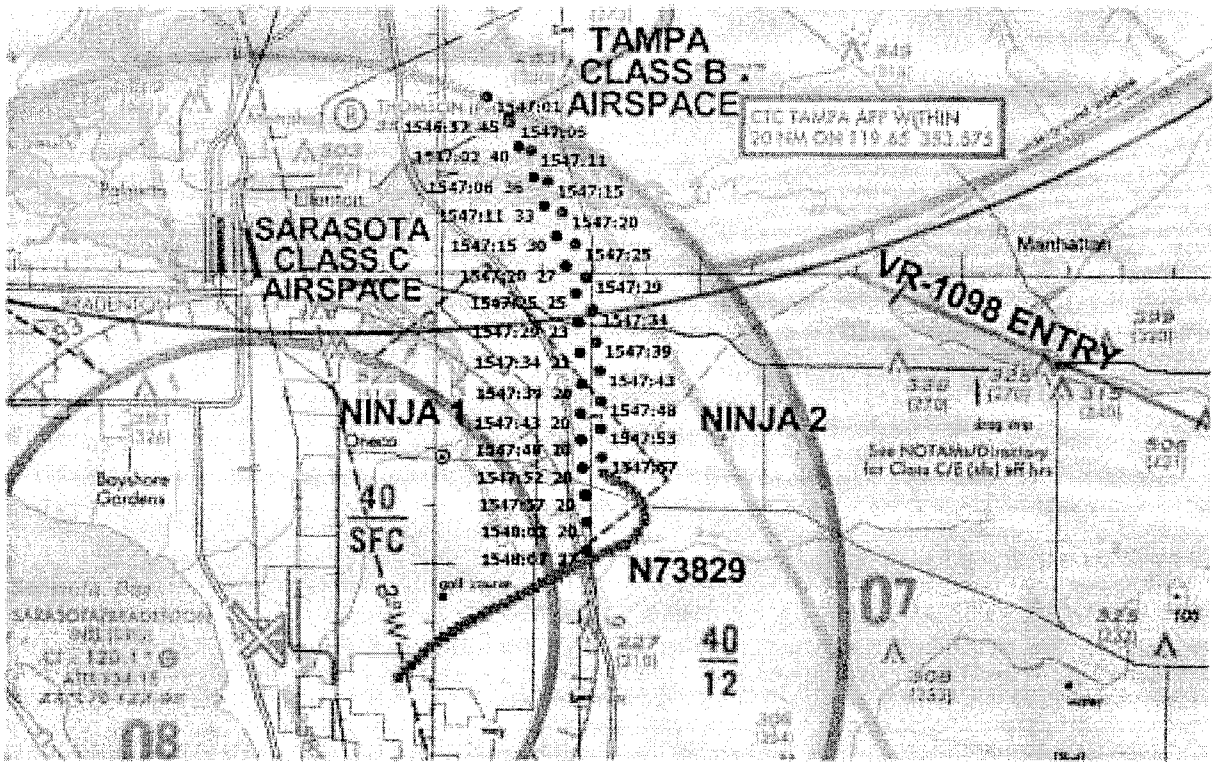

Figure 1. Radar tracks showing the flightpaths of Ninja1, Ninja2, and N73829.

About 1541, N73829 departed SRQ en route to the Albert Whitted Airport, St. Petersburg, Florida.[7] N73829 initially headed east. About 1545, the Tampa TRACON controller identified N73829 on radar and instructed the pilot to maintain 1,600 feet. About 1547, the controller instructed the pilot of N73829 to fly heading 320° and climb to 3,500 feet. The Safety Board notes that the pilot appears to have complied with all ATC instructions and

[6] ARTCCs have responsibility for all controlled airspace in the United States. In areas where high concentrations of air traffic are found, ARTCCs delegate ATC responsibility to TRACON facilities. TRACONs are normally responsible for airspace extending 30 to 60 miles from airports and up to 10,000 to 15,000 feet msl.

[7] Sarasota lies within class C airspace; therefore, the pilot was required to accept VFR traffic advisory services on take off.

followed standard procedures for operating in class C airspace. At no time did N73829 enter the boundaries of VR-1098.

Also about 1547, Ninja1 was heading south and descending through 4,300 feet on a converging course with N73829. By this time, Ninja1 had overshot its intended entry point to VR-1098, and, at this time, it was several miles southwest of the MTR. Ninja1 had also inadvertently passed through the Tampa class B airspace without the required ATC clearance and was about to enter the Sarasota class C airspace without establishing communications with ATC, which is required by Federal regulations. The Tampa TRACON mode C intruder[8] conflict detection software noted a possible conflict between Ninja1 (the airplane) and N73829 and, at 1547:39, generated an aural conflict alert in the TRACON facility that continued until 1548:03.[9] Subsequently, the Tampa controller informed N73829 that there was "traffic off your left side ahh two thousand"; however, because the flightpaths of the two targets (Ninja1 and N73829) did not indicate that a collision was imminent, he took no other action. The pilot of N73829 did not respond to the controller's statement.

The flightpath of N73829 was in direct conflict with that of Ninja2, which was approaching N73829 from the right. Ninja2 was flying less than 1 mile behind and slightly to the east of Ninja1. However, the conflict detection system did not account for Ninja2 or its possible conflict with N73829. This happened because technical limitations of ATC radar systems generally dictate that only the lead airplane of a formation flight can operate its transponder. As a result, other aircraft in formation flights normally do not operate their transponders. Therefore, Ninja2 could only be detected by Tampa's radar as a primary target, not a secondary target.[10] Primary targets are not eligible for conflict detection processing because no altitude information is available for them. Thus, the only way that the controllers could have detected the conflict between N73829 and Ninja2 would have been to visually observe Ninja2's primary target heading toward N73829's secondary target on the radar display. During postaccident interviews, Tampa controllers stated that they did not notice the Ninja2 primary target on their radar displays. The collision occurred about 2,000 feet msl, about 6 miles southwest of the entry point for VR-1098.

Dissemination of Information About Formation Flights and Military Training Routes

During postaccident interviews, the Tampa controllers stated that they were unaware that Ninja1 was a formation flight that included two aircraft. At ATC facilities that use printed flight progress strips,[11] information about the number of aircraft in a formation flight is usually

[8] The mode C intruder conflict detection software warns controllers when an aircraft receiving ATC radar service is predicted to conflict with other radar-observed traffic, even if the other aircraft is not under ATC control (as was the case with Ninja1).

[9] According to radar data, Ninja1 leveled off about 2,000 feet msl after its descent.

[10] Surveillance radar fall into two categories: primary and secondary. Secondary radar broadcasts an interrogation signal to equipment on board an aircraft that automatically responds by transmitting information to the ground-based site for processing and display. Secondary radar returns contain an identification code and altitude data. Primary radar broadcasts radio waves and detects the reflections of the waves off objects (including airplanes). Primary radar reflections do not contain any identification or altitude information.

[11] Flight progress strips are printed records of information about particular aircraft, such as aircraft identification, number and type of aircraft, airspeed, altitude, route of flight, and other pertinent remarks.

available to controllers in the "aircraft type" section of the flight progress strip. However, the investigation has revealed that local procedures at some TRACONs, including the Tampa TRACON, do not require the use of flight progress strips in all cases.[12] The Tampa TRACON does not ensure that controllers receive this information through other means. As evidenced by this accident, if controllers are unaware that a formation flight is in progress, they most likely will be focused on the flight lead and, therefore, will not take other aircraft in a formation flight into account when looking for and trying to prevent potential traffic conflicts. Further, FAA Order 7110.65, "Air Traffic Control," Paragraph 5-5-8, "Additional Separation for Formation Flights," states "because of the distance allowed between formation aircraft and lead aircraft, additional separation is necessary to ensure the periphery of the formation is adequately separated from other aircraft, adjacent airspace, or obstructions...Separate a standard formation flight by adding 1 mile to the appropriate separation minima." Therefore, controllers must have accurate information about the number of aircraft in formation flights to ensure adequate separation.

Further, at TRACONs that do not require the use of flight progress strips, controllers may also lack other important information, such as destination information, that would be displayed in the "remarks" section of a flight progress strip. Controllers at such facilities generally obtain flight destination information by observing an aircraft's radar data block. However, destination information for aircraft intending to fly to a VR entry point (or other airborne location) is too large to fit within the space allowed in the data block, and it is not displayed.[13] Therefore, the controller must obtain the destination information by asking the pilot for it on initial contact.[14]

Not having complete information may lead controllers to inadvertently apply less than required separation between formation flights and other IFR aircraft operating nearby or provide incomplete traffic advisory information to such aircraft. Therefore, the Safety Board believes that the FAA should amend procedures used at ATC facilities that permit operation without flight progress strips to ensure that controllers are provided with all information necessary to meet their separation and traffic advisory responsibilities, including all information on formation flights that would be displayed on flight progress strips.

Safety Board investigators also found that the Tampa TRACON controllers involved in this accident were unfamiliar with the existence and location of VR-1098 even though the route starts inside their area of responsibility. During postaccident interviews, when asked about what information on MTRs was included in the controller training program, a controller who had been providing instruction to a trainee at the sector at the time of the accident stated that there was

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[12] For example, the Safety Board became aware that the Charlotte, North Carolina, TRACON does not require the use of flight progress strips. FAA Order 7110.65, "Air Traffic Control," paragraph 2-3-1, states that "unless otherwise authorized in a facility directive, use flight progress strips to post current data on air traffic and clearances required for control and other air traffic control services."

[13] The destination information for Ninja1 was "MCF159023, 23 miles southeast of MacDill AFB," indicating that the IFR portion of the flight was to terminate 23 miles southeast of MacDill AFB on the 159° radial from the base.

[14] As noted previously, the Tampa TRACON controllers never communicated with Ninja1; therefore, the only information they received about the flight was from Miami ARTCC stating that it was "descending into some VR route."

"probably some mention of it." Further, the supervisor on duty at the time of the accident stated that he had never cleared an aircraft into VR-1098 and that the route is not used frequently.

In this case, the lack of awareness about Ninja1's intent to enter VR-1098 and about the location of the route's entry point reduced the Tampa TRACON controller's ability to detect and react to Ninja1's navigational error, notice its unapproved entries into class B and class C airspace surrounding the Tampa and Sarasota airports, and perceive the subsequent traffic conflict with N73829. Further, because MTRs are often used by aircraft operating at high speeds and low altitudes in airspace in which conflicts with other aircraft may occur, all controllers need to know about their existence and locations. Therefore, the Safety Board believes that the FAA should provide initial and recurrent training to all air traffic controllers regarding the location of all MTRs and the types of operations conducted on any MTRs beginning in, passing through, or terminating in their areas of responsibility.

Finally, the investigation revealed a deficiency in the accessibility of MTR and other safety information that relates to a particular route of flight. Title 14 CFR Section 91.103, "Preflight Action," requires that "each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight." The *Aeronautical Information Manual* (AIM), Paragraph 3-5-2, "Military Training Routes," states the following:

> Nonparticipating aircraft are not prohibited from flying within an MTR; however, extreme vigilance should be exercised when conducting flight through or near these routes. Pilots should contact FSS's [flight service stations] within 100 NM [nautical miles] of a particular MTR to obtain current information or route usage in their vicinity. Information available includes times of scheduled activity, altitudes in use on each route segment, and actual route width....When requesting MTR information, pilots should give the FSS their position, route of flight, and destination in order to reduce frequency congestion and permit the FSS specialist to identify the MTR which could be a factor.

Further, AIM, Paragraph 7-1-3, "Preflight Briefing," states the following:

> Pilots may obtain the following from AFSS [automated flight service station]/FSS briefers upon request:
>
> (a) Information on military training routes (MTR's) and military operations area (MOA's) activity within the flight plan area and a 100 NM extension around the flight plan area.
>
> NOTE - Pilots are encouraged to request updated information from en route AFSS's.[15]

[15] Similarly, FAA Order 7110.10, "Flight Services," Paragraph 3-2-1, "Conduct of Standard Briefing," states that FSS briefers should, upon request, do the following: "provide information on military training routes (MTR) and military operations area (MOA) activity within your flight plan area plus an additional 100 NM extension. For briefings beyond the above stated area, advise the pilot that information may be incomplete and to contact other en route facilities for additional information."

This guidance appears to indicate that if a pilot requests information about MTRs, the FSS briefer will determine which MTRs affect the aircraft's route and provide the pilot with the appropriate MTR usage information. However, information received from FSS personnel during followup investigation of this accident indicates that pilots are not likely to receive such service. FSS personnel indicated that their current automated briefing system is unable to correlate a pilot's route of flight with particular MTRs and, therefore, that FSS briefers expect pilots to ask for MTR information by specific route number so that the information about that route can be obtained from a separate database, which is not accessible through the automated briefing system.

In this case, the pilot of N73829 most likely did not seek information about MTRs because his intended route of flight did not intersect the only MTR in the vicinity (VR-1098). Nonetheless, the Safety Board is concerned that pilots, FSSs, and ATC facilities do not have access to a reliable means of identifying active MTRs and other possible hazards to flight, such as special use airspace and temporary flight restrictions. According to FAA Aviation Safety Reporting System staff, 141 incidents were reported between 1995 and 2000 that involved operations on MTRs. Further, the FAA's Near Midair Collision Database contains several reports of near midair collisions between aircraft operating on or in the vicinity of MTRs. To reduce the likelihood of such incidents, preflight briefings should provide pilots with reliable information on all airspace-related activities known to the FAA that may present a hazard to flight or otherwise require increased vigilance by pilots. This may require the development of automation systems that are capable of comparing pilot-provided information with available airspace status information and automatically detecting situations in which conflicts may occur.

Although basic MTR usage information is generally available from various sources, such as FSSs, Direct User Access Terminal briefings, military base operations, and VFR charts, it is not organized and presented in a manner that can be quickly applied to a particular route of flight. Therefore, the Safety Board believes that the FAA should develop automation capabilities to ensure that pilots, FSS briefers, and air traffic controllers can access current and comprehensive information on MTRs, special use airspace, and other safety-of-flight information that is organized and presented in a manner in which it can be readily understood and applied to specific flight operations.

Radar Traffic Advisory Services for Military Flights Operating Under Visual Flight Rules

On September 7, 2000, a near midair collision occurred between a Boeing 757 and a USAF F-117 operating under VFR approximately 11,000 feet over Los Angeles International Airport, Los Angeles, California.[16] In response, Safety Board investigators met with USAF representatives to identify actions that could reduce the likelihood of conflicts between military training flights and civil aircraft operations. As a result, the USAF amended Air Force Instruction 11-202, "General Flight Rules," effective February 9, 2001, to require pilots of USAF aircraft operating under VFR to request and utilize VFR radar traffic advisory services to the maximum extent practical. It is possible that the collision between N73829 and Ninja2 might not have occurred if this instruction had been in effect at the time of the accident and Ninja1 had

[16] For more information, see NTSB Safety Recommendation A-01-11, April 24, 2001.

complied with it and continued receiving radar traffic advisory services after it canceled its IFR flight plan. To facilitate compliance with this USAF instruction, the Safety Board believes that the FAA should ensure that all controllers responsible for providing radar traffic advisory services are briefed on both the September 7, 2000, near midair collision in Los Angeles and the November 16, 2000, midair collision near Bradenton, Florida. Further, the Safety Board believes that the FAA should amend FAA Order 7110.65, "Air Traffic Control," to require that air traffic controllers provide radar traffic advisory services to military aircraft operating under VFR whenever radar and communications coverage permits.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Amend procedures used at air traffic control facilities that permit operation without flight progress strips to ensure that controllers are provided with all information necessary to meet their separation and traffic advisory responsibilities, including all information on formation flights that would be displayed on flight progress strips. (A-02-15)

Provide initial and recurrent training to all air traffic controllers regarding the location of all military training routes (MTR) and the types of operations conducted on any MTRs beginning in, passing through, or terminating in their areas of responsibility. (A-02-16)

Develop automation capabilities to ensure that pilots, flight service station briefers, and air traffic controllers can access current and comprehensive information on military training routes, special use airspace, and other safety-of-flight information that is organized and presented in a manner in which it can be readily understood and applied to specific flight operations. (A-02-17)

Ensure that all controllers responsible for providing radar traffic advisory services are briefed on both the September 7, 2000, near midair collision in Los Angeles, California, and the November 16, 2000, midair collision near Bradenton, Florida. (A-02-18)

Amend FAA Order 7110.65, "Air Traffic Control," to require that air traffic controllers provide radar traffic advisory services to military aircraft operating under visual flight rules whenever radar and communications coverage permits. (A-02-19)

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred with these recommendations.

Original Signed

By: Marion C. Blakey
Chairman